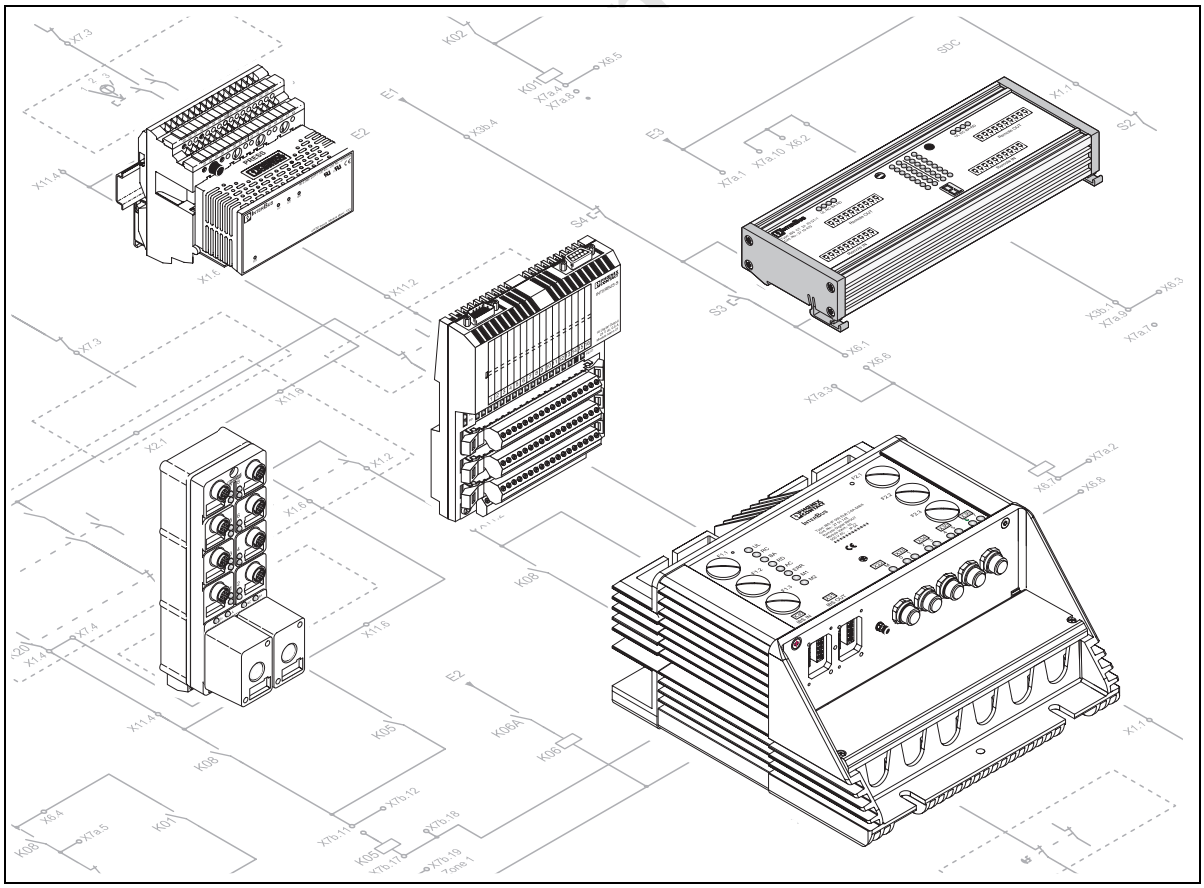
PHOENIX CONTACT
INSPIRING INNOVATIONS

User Manual

Configuring and Installing INTERBUS

Designation: IBS SYS PRO INST UM E
Order No.: 27 43 80 2



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Designation: IBS SYS PRO INST UM E

Revision: AC02

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This manual is valid for:
- ST modules (Smart Terminals)
- RT modules (Remote Terminals)
- CT-I/O gateways (Configurable Terminals)
- Sensor/actuator boxes (SAB)
- 500 V version of the INTERBUS motor starter

6000AC02

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Please Observe the Following Notes:

In order to guarantee the safe use of your device, we recommend that you read this manual carefully. The following notes give you information on how to use this manual.

Requirements on the User Group

The use of products described in this manual is oriented exclusively to qualified electricians or persons instructed by them, who are familiar with applicable national standards. Phoenix Contact assumes no liability for erroneous handling or damage to products from Phoenix Contact or external products resulting from disregard of information contained in this manual.

Explanation of Symbols Used

The *attention* symbol refers to an operating procedure which, if not carefully followed, could result in damage to equipment or personal injury.

The *note* symbol informs you of conditions that must strictly be observed to achieve error-free operation. It also gives you tips and advice on hardware and software optimization to save you extra work.

The *text* symbol refers to detailed sources of information (manuals, data sheets, literature, etc.) on the subject matter, product, etc. This text also provides helpful information for the orientation in the manual.

We are Interested in Your Opinion

We are constantly attempting to improve the quality of our manuals.

Should you have any suggestions or recommendations for improvement of the contents and layout of our manuals, we would appreciate it if you would send us your comments. Please use the universal fax form at the back of the manual for this.

Statement of Legal Authority

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Internet

Current product information is also available on the Internet at **www.phoenixcontact.com**.

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Section 1

This section informs you about
– working with this user manual
– the most important INTERBUS data

1 INTERBUS System Basics

1.1 About This User Manual

This manual is for everybody who wants to configure an INTERBUS system. It only describes the product families:

– ST modules (Smart Terminals)
– RT modules (Remote Terminals)
– CT-I/O gateways (Configurable Terminals)
– Sensor/actuator boxes (SAB)
– 500 V version of the INTERBUS motor starter

The first section of this manual introduces you to the INTERBUS basics. Section 1.3 explains the most important terms.

The INTERBUS modules are described in product families (Section 4 to Section 8). These descriptions contain general information that applies to each module of the family. If you need specific information on a module refer to the module-specific data sheets at www.phoenixcontact.com.

The index at the end of this manual helps you to get information on a certain topic.

Some product families are described in a special system manual. All user manuals for the product families which are **not** described here can be found at www.phoenixcontact.com. You can also order hard copies of the following system manuals:

INTERBUS Inline
– Configuring and Installing the INTERBUS Inline Product Range
IB IL SYS PRO UM E, Order No. 27 43 04 8

INTERBUS Loop 2
– Configuring and Installing the INTERBUS Loop 2 Product Range
IB L2 SYS PRO UM E, Order No. 27 43 49 1

INTERBUS Rugged Line
– Configuring and Installing the Rugged Line Product Range
IBS RL SYS PRO UM E, Order No. 27 43 78 9

In addition to the system manuals, installation guidelines are also available for certain motor starters.

– Mounting and installation of the steel sheet motor starter
  DB GB IBS IP 400 ELR INST, Part No. 90 00 15 9
– Mounting and installation of the high-grade steel motor starter
  DB GB IBS 400 ELR/MLR-F INST, Part No. 90 00 15 7

1.2 Relevant Standards

The following German and international standards have to be observed for the installation of an INTERBUS system. Standards or regulations in the land of application must be followed. In this case the standards listed here are substituted.

- DIN VDE 0100 "Erection of power installations with nominal voltages up to 1000 V"
  - Part 410 "Protection for safety; protection against electric shock" (IEC 60364-4-41, modified)
  - Part 540 "Selection and erection of equipment; earthing arrangements, protective conductors, equipotential bonding conductors" (IEC 60364-5-54)
  - Part 707 "Earthing requirements for the installation of data processing equipment"
- DIN VDE 0110-1 "Insulation coordination for equipment within low-voltage systems" (IEC 60664- 1, modified)
- DIN VDE 0160 "Electronic equipment for use in electrical power installations" (DIN EN 50178)
- DIN VDE 0185-1 "Lightning protection systems" - Part 1: "General with regard to installation" (DIN 57185-1)
- DIN VDE 0470-1 "Degrees of protection provided by enclosures (IP code)" (IEC 60529, EN 60529)
- DIN EN 50100-1 "Safety of machinery - electrosensitive protective equipment; general requirements and tests"

Operations and procedures that are not standardized have to be carried out according to the current state of technology and safety.

1.3 Introducing the INTERBUS System

INTERBUS is a serial bus system which transmits data between control systems (e.g., PLCs, PCs, VMEbus computers, robot controllers etc.) and distributed I/O modules that are connected to sensors and actuators (operator equipment, indicators, drives etc.).

INTERBUS has a ring structure. The ring structure allows INTERBUS to send and receive data simultaneously.

INTERBUS is a single master system. A master (the controller board) controls all devices of an INTERBUS ring.

From the controller board, all devices are connected to the bus system. Each device has two separate lines for data transmission: one for forward data transfer and one for return data transfer. This eliminates the need for a return line from the last to the first device, necessary in a simple ring system. The forward and return lines run in one bus cable. From the installation point of view, INTERBUS has a tree structure as only one cable leads from one device to the next.

In the INTERBUS topology the single bus devices can be differentiated by means of their position in the system. There are controller boards, bus terminal modules (BK modules), remote bus devices, installation remote bus devices and local bus devices.

1.3.1 Describing the Bus Components

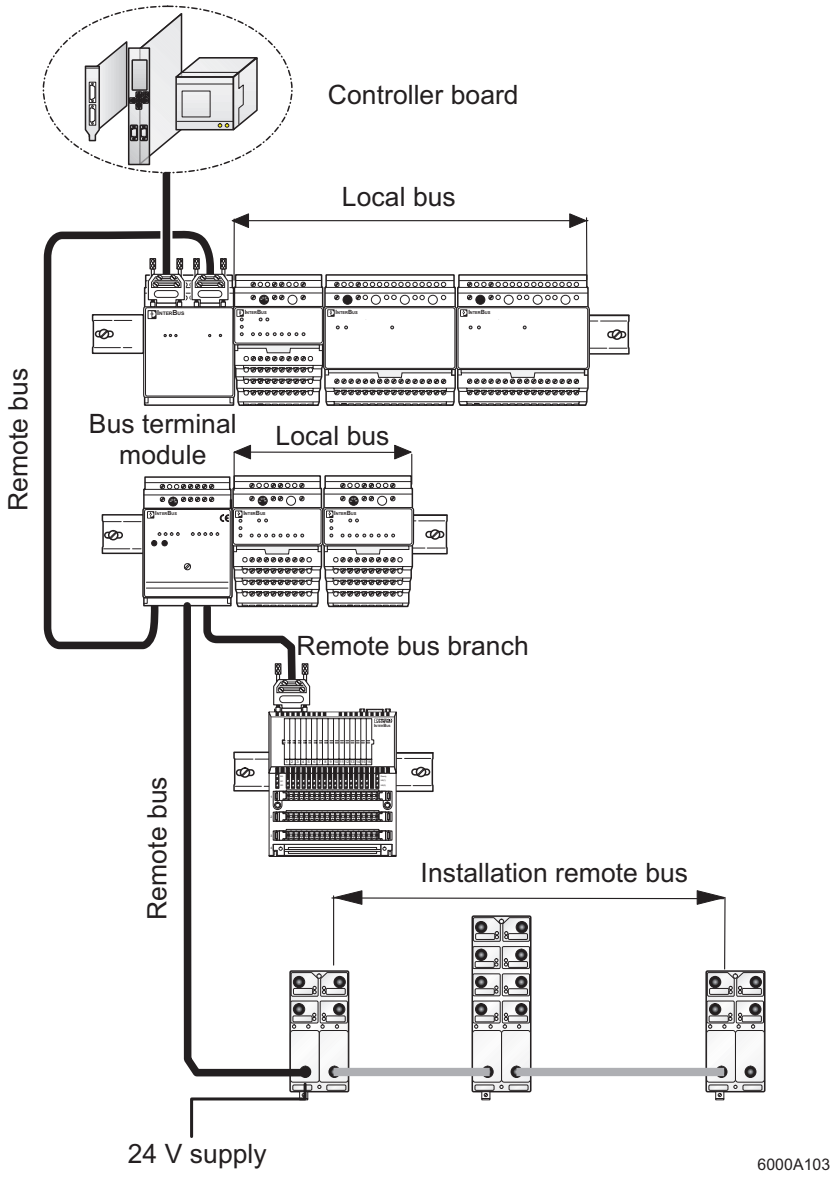


Figure 1-1 Example of a bus configuration

Controller board

The controller board takes over the master function in the INTERBUS network. It organizes the data traffic in the INTERBUS system, independent of the control or computer system in which it is installed.

Controller boards are available for a wide range of control and computer systems.

Tasks of the controller board:

– Transmitting output data to the output modules
– Reading the input data of the modules
– Monitoring INTERBUS
– Sending error messages to the host system
– Indicating diagnostic messages
– Controlling the cyclic I/O protocol

Bus terminal module (BK module)

The first step in setting up a modular I/O station is to connect the BK module to the INTERBUS remote bus cable. I/O modules may be installed branching off from these BK modules, to create a local bus.

A BK module divides the system into segments, thus allowing you to switch off single branches during operation. In addition, the BK module supplies communications power to the connected I/O modules.

A BK module must be supplied with non-interruptible voltage. This means that the voltage may not be off at the same time as the subsystem if the whole bus system is to continue operation. A breakdown of the supply voltage on the BK module stops the system and causes an error message for the bus segment.

Tasks of the BK module:

– Coupling of the remote bus and local bus
– Supplying the I/O modules with communications power
– Updating the data signal (repeater function)
– Electrical isolation of the bus segments
– Connecting or disconnecting the local bus via firmware (disconnecting via hardware is only possible if fiber optic interfaces are used). The outgoing remote bus can be disconnected for Generation 4 or later.
– Error message via an electrically isolated alarm output (e.g., sound signal, light signal)

Remote bus

The remote bus cable connects the controller board with the remote bus devices and the remote bus devices with each other.

Remote bus devices are BK modules, certain I/O modules or a mixture of both. Each has a local voltage supply and an electrically isolated outgoing INTERBUS segment.

Installation remote bus

In addition to the data transmission lines, the remote bus can also carry the supply line for the connected I/O modules and the sensors (installation remote bus).

Local bus

A local bus is a bus connection that branches off from a remote bus via a BK module and connects the local bus devices with each other. The BK module supplies the connected devices with communications power. The switching voltage for the outputs must be connected separately to the output modules.

Local bus devices are I/O devices used for the structuring of a decentralized substation in a control cabinet. The devices are connected to the remote bus via a BK module. Within the local bus, branching is not allowed.

Remote bus branch

A remote bus branch is a branch off the remote bus. A branch is connected to the main line via a special BK module. This BK module allows for the connection and disconnection of the branching bus segment.

Bus segment

A bus segment consists of a remote bus device and the I/O modules connected to it. The preceding cable is also part of the segment.

I/O module

I/O modules connect INTERBUS to the sensors and actuators.

ID code

Each INTERBUS module has an ID code that identifies it to the controller board or the configuration software. The ID code indicates the module type.

Length code

The length code indicates the number and representation format of the process data (bit, nibble, byte, word).

1.3.2 INTERBUS System Data

Table 1-1 System data

System	
Number of I/O points	4096, maximum
Number of data words	256, maximum
Transmission speed	500 kbits/s
Transmission reliability	CR check (Hamming distance: 4)
Protocol	DIN EN 50254
Number of Devices	
Total number of bus devices	512, maximum
Number of remote bus devices	254, maximum
Distances	
From the controller board to the last remote bus device	12.8 km (7.954 mi.), maximum (copper)
	80 km (49.710 mi.), maximum (glass fiber)
From the controller board to the first device	400 m (1312.336 ft.), maximum (copper)
	50 m (164.042 ft.), maximum (polymer fiber)
	300 m (984.252 ft.), maximum (HCS fiber)
	3000 m (9842.520 ft.), maximum (glass fiber)
Between two remote bus devices	400 m (1312.336 ft.), maximum (copper)
	50 m (164.042 ft.), maximum (polymer fiber)
	300 m (984.252 ft.), maximum (HCS fiber)
	3000 m (9842.520 ft.), maximum (glass fiber)
Between two installation remote bus devices	50 m (164.042 ft.), maximum (copper)
Between BK module and installation remote bus device	50 m (164.042 ft.), maximum (copper)

Dimensioning the Remote Bus

The remote bus covers large distances within a system. The entire remote bus can have a length of 12.8 km (7.954 mi.) (up to 80 km [49.710 mi.] with glass fiber cable), measured from the controller board up to the last remote bus module connected. The remote bus can be divided into up to 254 segments.

One bus segment consists of a BK module, or remote bus interface device and the remote bus cable connected to its remote bus IN connector. With copper cables the remote bus can cover a distance of 400 m (1312.336 ft.).

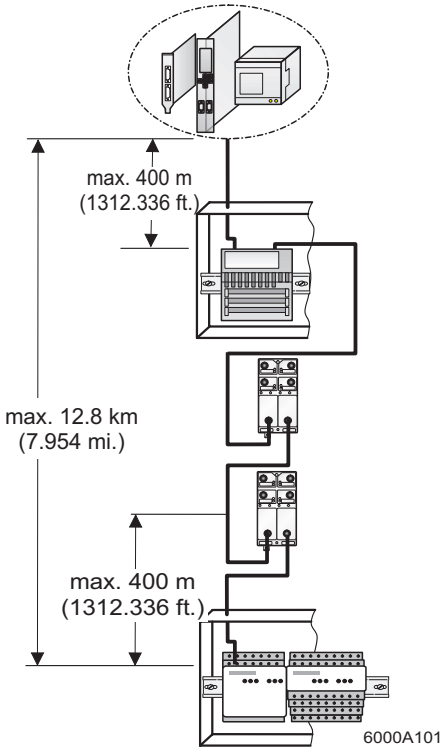


Figure 1-2 Maximum cable lengths in the remote bus (copper cable)

Dimensioning the Installation Remote Bus (IRB)

Certain product families (sensor/actuator boxes, motor starters) allow connection to the remote bus with a hybrid cable, called installation remote bus. Installation remote bus cables carry communications/sensor power and data to I/O devices.

When using IRB cable, the distance between the BK module and the last I/O device must not exceed 50 m (164.042 ft.).

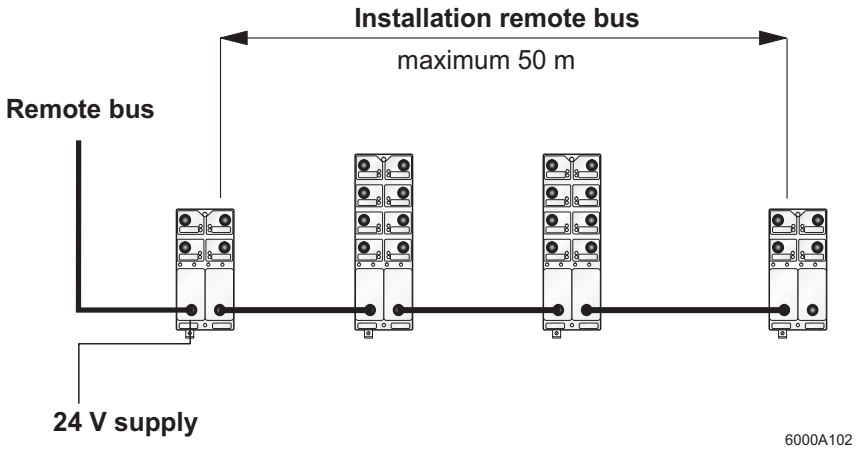


Figure 1-3 Maximum cable lengths in the installation remote bus

The number of I/O devices in the installation remote bus is limited by the current consumption of the devices and the connected sensors (see „INTERBUS Devices for Dimensioning the Bus Structure“ auf Seite 3-11). The total current consumption of these components must not exceed 4.5 A. The current consumption of the actuators is not added to the calculation, as the actuators are supplied with a separate I/O voltage.

Overview of the Dimensioning of Subsections

Table 1-2 INTERBUS subsections for copper cable

Remote Bus	Installation Remote Bus	Local Bus
Maximum total current consumption		
–	4.5 A	0.8 A
Maximum cable lengths (copper cable)		
Between controller board and first remote bus device 400 m (1312.336 ft.)	Between BK module and first installation remote bus device 50 m (164.042 ft.)	–
Between two remote bus devices 400 m (1312.336 ft.)	Between two installation remote bus devices 50 m (164.042 ft.)	ST devices must be directly mounted side by side.
Between controller board and last remote bus device 12.8 km (7.954 mi.)	Between BK module and last I/O device 50 m (164.042 ft.)	–
Maximum number of devices		
254	254 (Limited by the total current consumption of the sensors)	8 (4 if IBS ST 24 BKM-T modules are used) (Limited by the total current consumption of the ST devices)
Bus connection		
9-pos. D-SUB screw-clamp terminal blocks (MINI-COMBICON)	SAB connector hood	ST cable (local bus)

1.3.3 Transmission Medium

The standard transmission type is using twisted-pair cables, but INTERBUS can also use other media such as fiber optics, slip rings and infrared transmission paths. That means that INTERBUS can also reach parts of the system that cannot be accessed with copper cables.

Copper cable

Standard interface. Up to 400 m (1312.336 ft.) can be covered between two stations.

Standard cables are available for:

– Indoor installation
– Flexible applications (e.g., moving, flexible cable track)
– Underground installation

Fiber optics

There are three different types of fiber optics:

– Polymer fiber cables are easier to assemble than the below mentioned fiber optics: With polymer fibers approx. 50 m (164.042 ft.) between two remote bus devices can be covered. (For exact distances see the "Optical Fiber Installation Guidelines", Designation DB GB IBS SYS FOC ASSEMBLY, Part No. 94 23 43 9.)
– HCS cable is a hybrid fiber with glass fiber core and plastic fiber sheathing. The assembly is complicated and up to 300 m (984.252 ft.) between two remote bus devices can be covered. (For exact distances see the "Optical Fiber Installation Guidelines", Designation DB GB IBS SYS FOC ASSEMBLY, Part No. 94 23 43 9.)
– Glass fiber assembly is very complicated. With polymer fibers approx. 3000 m (9842.520 ft.) between two remote bus devices can be covered.

Slip rings

Slip rings allow data transmission to rotating parts.

Infrared transmission paths

Infrared transmission paths are used instead of a trailing cable. Infrared transmission modules convert INTERBUS data signals to infrared light. These modules transmit and receive data up to 200 m (656.168 ft.) and eliminate the need for an interconnecting cable.

1.3.4 Data Transmission Method

The INTERBUS system uses serial data transmission.

Summation frame protocol

For the controller board, all sensors and actuators, including their data, are grouped together as one "logical" device. The frame data, like start and end ID, is only sent once per cycle for each device. That means that the more I/O devices that are connected, the more the user data / frame data ratio improves. This transmission method is called summation frame protocol.

Shift register

Each INTERBUS device has internal shift registers through which data is transferred. In each bus cycle the new data pushes the old data by one register so that each bus device sends and receives data within a bus cycle. If the controller board "knows" which devices are connected to the bus, the controller board can assign the I/O data to the single devices. Therefore, each device has a device code indicating the module type and the data length.

INTERBUS devices have two different types of shift registers: identification registers and data registers.

This leads to two different cycle types in the system:

Identification cycle (ID cycle)

The identification cycle is run to start up the system and localize errors. The controller board needs this cycle to identify the devices in the INTERBUS system. Each device places its ID code in the ring.

The ID register is not part of the register length calculation. The register length by means of which an INTERBUS device is connected to the data ring only depends on the length of its data register.

Data cycle

The second cycle type is the data cycle. This cycle is always run when data is transmitted.

At the start of the cycle, the controller board generates the loop-back word. The controller board clocks and pushes the first bit of the loop-back word from the controller board to the first device. The first device pushes its last bit (less significant) to the next device. This device pushes its less significant bit to the next device, etc. This simultaneous sending and receiving of data is called full duplex operation.

The controller board keeps clocking until the loop-back word has returned.

CR check

After the transmission of the user data, an end ID is transmitted for data security, the CRC sequence. Each device checks the CRC before it accepts data from the IN register to the OUT register. If a CRC error is detected the output data is not accepted and only the I/O data is read. This method ensures that new data is available to all devices at the same time. This is also valid for the controller board. Within the data cycle, all devices have received new output data and the controller board has received new input data from the devices.

Transmission of Process and Parameter Data

Different input/output devices are used in the field of sensors/actuators. Among these devices are those processing only very little information like valves or switches. Information from such devices is process data transmitting status information such as switch positions. The transmission of such data must be quick and cyclical.

Intelligent devices like frequency inverters or controllers exchange process data with each other and they also exchange large data amounts with the control system. Such data can, for example, be needed for the startup phase of a machine. This parameter data rarely changes and is only transmitted if required.

The INTERBUS protocol can transmit simple input/output data (process data) and complex data records (parameter data) at the same time. For this, the complex parameter data is divided into small units, transmitted and put together again.

In the INTERBUS system the Peripherals Communication Protocol (PCP) divides the parameter data into single segments. After the transmission it recombines the data. PCP designates the protocol software. This software makes connection establishment and connection abort possible.

For detailed information on PCP communication refer to the IBS SYS PCP G4 UM E User Manual, Order No. 27 45 16 9.

1.3.5 Differences Between Generation 3 (G3) and Generation 4 (G4)

The designations G3 and G4 refer to the controller board version with the corresponding software. A G3 controller board can be parameterized with CMD G3 software.

All INTERBUS devices described in this user manual can be operated on the bus system with controller boards of both generations.

– G4 supports INTERBUS Loop devices and has improved diagnostics for each single device.
– The two generations have different addressing methods.
– Only the branching interface on the BK module can be disconnected with G3. With G4 the outgoing interface can also be disconnected.
– G4 controller boards can synchronize bus and control cycle times.
– As of G4 the control system is offloaded in such a way that the data can be output directly without running through the control system. There are two possibilities. The (time-critical) input signals can be transferred directly to output signals without the link through a condition (direct link). These time-critical input signals can be linked with/through conditions and then directly transferred to output signals (preprocessing).
– PCP version 2.0 integrated in G4 firmware supports a PCP channel width of 1, 2 and 4 words and has better immunity to interference. Communication of PCP devices with each other is possible (peer-to-peer communications).
– As of G4 a remote bus branch can be further branched. Up to 16 bus levels (branching) are allowed (see section "Remote bus structure with 16 levels (G4)" on page 1-18). A BK module can be connected to a BK module as a branch. This is not possible in G3. The local bus is part of the next level.
  The creation of sub-branches, e.g., for routing the cable in a system (with no return cable) or for connecting/disconnecting single bus branches is another advantage.

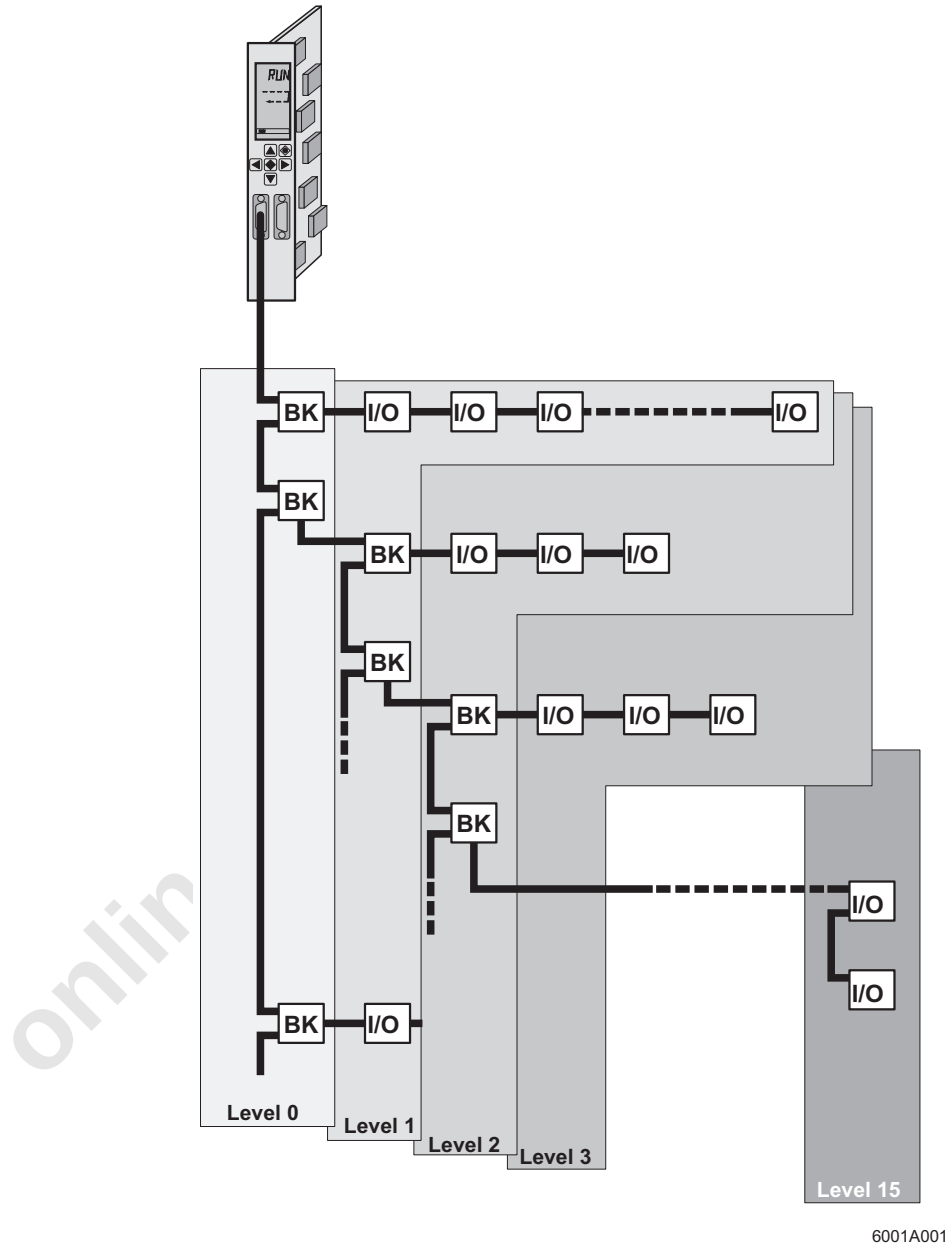


Figure 1-4 Remote bus structure with 16 levels (G4)

Table 1-3 Differences between G3 and G4

Generation 3	Generation 4
2 device levels	16 device levels
INTERBUS Loop is not supported	INTERBUS Loop is supported
Optional: One-line display	Optional: Four-line display (text display, more effective diagnostics)
Limited addressing of the INTERBUS devices	Extended addressing possibilities of the INTERBUS devices
Synchronous operation is not supported	Synchronous operating modes possible
Simple direct link	Extended, flexible direct link
Simple preprocessing	Extended, flexible preprocessing
Static RAM board	Parameterization memory (can be deleted and changed)
Devices with a data width below 8 bits are not supported	4-bit devices are supported
Firmware download is not possible	Firmware download is possible
PCP version 1.5	PCP version 2.0

1.4 Overview of the Product Families

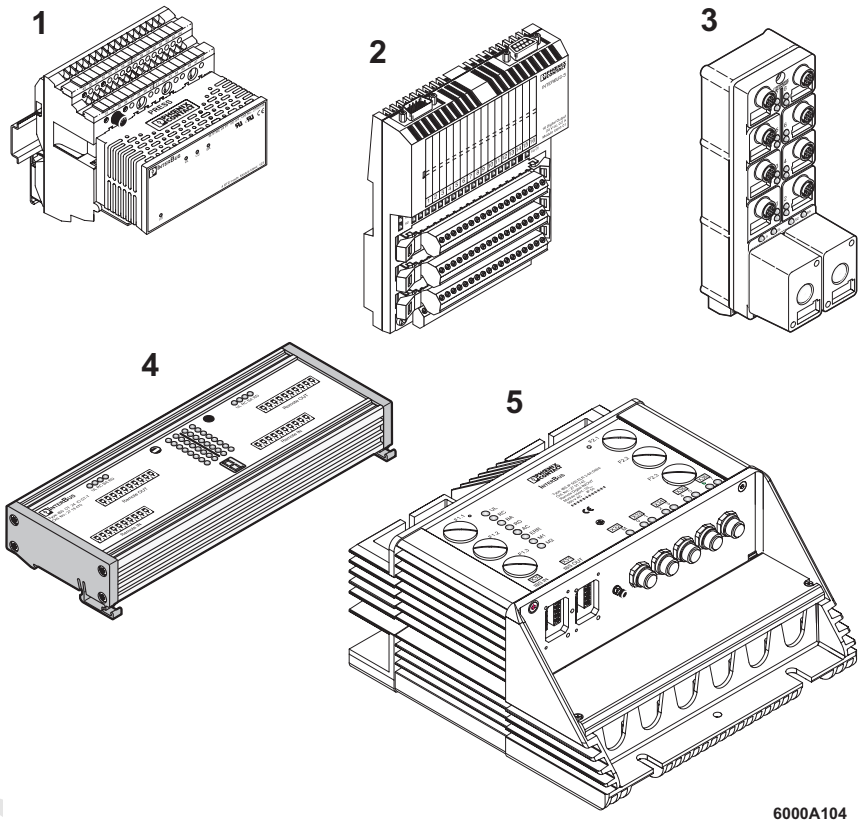


Figure 1-5 Overview of the INTERBUS modules

1 ST module (Smart Terminal)

2 RT module (Remote Terminal)

3 SAB module (Sensor/Actuator Box)

4 CT-I/O gateway (Configurable Terminal)

5 500 V version of the INTERBUS motor starter

Table 1-4 Overview of the INTERBUS product families

Product Family		Features	Page
Smart Terminals	**ST**	– Modular design – Directly adding one module to the next – Passive terminal block base – Plug-in electronics module – Screw-clamp or spring-clamp connection – Alternative fiber-optic bus connection (for BK modules) – For I/O stations with medium to high number of I/Os or functional groups – BK module can connect or disconnect the local bus devices	4-3
Remote Terminals	**RT**	– Flat housing types for installation in control cabinets, distribution boxes or operating units – Plug-in terminal block bases – Screw-clamp or spring-clamp connection – For I/O stations with low to medium number of I/Os – Remote bus devices	5-3
Configurable Terminals	**CT**	– Flat-pack design for installation in cable ducts – Extended temperature range – Bus connection via MINI-COMBICON – Alternative fiber-optic bus connection – Remote bus devices	6-3

Table 1-4 Overview of the INTERBUS product families

Product Family		Features	Page
Sensor/actuator boxes	**SAB**	– IP 67 protection – 5-pos. M12 connector for the connection of sensors/actuators – Direct control of actuators possible through 2 A outputs – Remote bus or installation remote bus devices	7-3
500 V version of the INTERBUS motor starter		– IP 54 – Plug-in connection method – Power networking (500 V AC) – Remote bus or installation remote bus devices	8-3

1.4.1 Explanation of the Product Designation

The designations of the INTERBUS products indicate functions, e.g., IBS ST 24 BK DIO 8/8/3-T.

IBS IB	Design	Voltage	Task	Number of inputs/ outputs	Connection method	Exten- sions

5109B101

IBS	INTERBUS (remote bus devices)
IB	INTERBUS (local bus devices)

Design	
BA	Bosch controller board
BC	Generation 4 controller board without diagnostic display and limited range of functions (basic controller)
CB	Generation 3 controller board
CC	Compact controller housing
CPCI	Compact PCI bus (32 bits)
CT	CT module (configurable terminal)
DCB	Generation 3 controller board with diagnostic display
DSC	Generation 4 controller board with diagnostic display
ETH	Ethernet controller board
FC	Field Controller
GE	GE Fanuc controller board
IBSL	INTERBUS Loop module
IL	Inline
IP	IP 67/65/54... protection
IPC	Möller controller board
IPCI	Industrial PCI bus (32 bits)
IPKES	IP 67 KES protection
IPKIS	IP 67 KIS protection
ISA	PC ISA bus (8/16 bits)
L2	INTERBUS Loop 2
MEA	Mitsubishi MELSEC controller board
PC	Controller board for IBM-compatible PCs
PCI	PC PCI bus (32 bits)
PLC5	Allen-Bradley controller board
RFC	Remote Field Controller
RL	Rugged Line module

RT	RT module (remote terminal)
S5/S7	Siemens SIMATIC controller board
SAB	Sensor/actuator box
SC	Generation 4 controller board without display (standard controller)
SL	INTERBUS Loop
ST	ST module (smart terminal)
ST ZF	ST module with spring-clamp connection
VME	VMEbus controller board

Supply Voltage

24	24 V DC
120/230	120/230 V AC
500	500 V AC
400	400 V AC

Task/Function

AI	Analog input module
AIO	Analog input/output module
AO	Analog output module
BDO/BDI **BAO/BAI**	Basic version of the corresponding module
BK	Bus terminal module
BKM	Basic bus terminal module
CBK	Bus terminal module for the installation remote bus
CDI/CDO	Digital installation remote bus input/output module
CNT	Counter module
DI	Digital input module
DIO	Digital input/output module
DO	Digital output module
ELR	Electronic load relay
FT	Fault-tolerant
GT	I/O gateway
INC	Incremental encoder module
MLR	Mechanical load relay
PT	Resistance temperature sensors
R/RELS	Relay output
SEB	High-speed exciter module
UTH	Thermocouples
V.24	Serial connection V.24/RS-232

VFD	Frequency inverter
WT	Extended temperature range

Number of Inputs/Outputs and/or Connection Method/Slots/Groups

Examples:

16/4	16 inputs with 4 groups
16/8	16 inputs on 8 slots
24/16	24 inputs, 16 outputs
32/2	32 channels, 2-wire technology

Extensions

-2A	Current limit
-LK	With fiber-optic connection
-S	Special function
-T	With copper remote bus connection (twisted pair)
/BP	Bipolar
/ETH	With Ethernet interface
/I	With electrical isolation
LB/RB	Local bus/remote bus
-SF	With special function

1.5 INTERBUS Software

The programs IBS CMD (for standard controller boards) and IBS PC WORX (for Field Controllers) are available for the configuration operation and parameterization of your INTERBUS system. With these programs you can configure, program and visualize all devices integrated in the INTERBUS system.

IBS CMD is the INTERBUS-specific user interface for the configuration operation, monitoring and diagnostics of field devices. Complex functions are clearly structured and arranged. All devices can be parameterized, operated and diagnosed from a central location.

IBS CMD is available in different versions for G3 and G4 INTERBUS controller boards.

In addition to IBS CMD functions, PC WORX offers a programming interface according to IEC 61131-3 and optional process visualization.

PC WORX requires the use of certain G4 controller boards (Field Controllers/Remote Field Controllers). Field Controllers can only be configured and parameterized with PC WORX. The programs run completely on the Field Controller so that the host PC is free for operation and visualization tasks.

1.5.1 IBS CMD (G3 and G4)

Interactive and control-independent configuration, operation and diagnostics of all connected devices in an INTERBUS system is possible with IBS CMD software.

IBS CMD runs on standard PCs under MS WINDOWS® and can be used for a number of INTERBUS controller boards.

The PC is coupled to the controller board through a serial interface (RS-232).

The IBS CMD program is divided into three program parts. These program parts can be operated in the following logical sequence:

Configuration

1. The configuration menu commands in IBS CMD are used to design a complete bus architecture for a system and to configure all the devices connected to INTERBUS. For example, you can add new devices or search for certain devices. Addresses can be assigned to the input/output channels of the bus devices. Single bus segments can be grouped together. It is also possible to test the bus architecture before startup.

Monitoring

2. All of the connected devices can be monitored and influenced by the "monitor" program extension. During system operation, the I/O states of connected devices can be indicated and output states can be changed.
   The dialog functions enable a partial startup of the system. For testing single system parts, the entire bus system and the control system do not have to be installed.

Diagnostics

3. During startup and servicing, the "diagnostics" operating state helps you to localize and eliminate error sources in the system. In this way, a defective bus device can be detected.
   During bus operation, you can give qualitative and quantitative statements about the transmission quality of the bus system.

For additional information on the IBS CMD SWT program please refer to the IBS CMD SWT G3 UM E (Order No. 27 53 95 7) or
IBS CMD SWT G4 UM E (Order No. 27 22 25 0) User Manual.

1.5.2 PC WORX

PC WORX software allows you to configure, program and diagnose processes.

PC WORX runs under MS Windows® version 3.1 and can only be used with Field Controllers (FC) or Remote Field Controllers (RFC). The host PC is only used for operation and visualization as the programs run completely on the Field Controller.

The PC is coupled to the Field Controller through an RS-232 interface or an Ethernet interface.

PC WORX consists of two parts: SYSTEM WORX and PROGRAM WORX. In addition, visualization software with PC WORX drivers can be installed on the PC WORX basic package.

The configuration and programming data (e.g., the user-defined variables) is available to the other program parts through a common database.

SYSTEM WORX

The entire INTERBUS system and the connected devices can be configured, parameterized and diagnosed with SYSTEM WORX.

INTERBUS data is not accessed through addresses but through user-defined variables.

PROGRAM WORX

PROGRAM WORX is a programming software based on the IEC 61131 standard. This programming software contains five programming languages:

- IL (Instruction List)
- FBD (Function Block Diagram)
- LD (Ladder Diagram)
- ST (Structured Text)
- SFC (Sequential Function Chart)

Visualization

You can graphically display the system structure and sequence with visualization software. You can also create a user interface to read and write data during operation.

Phoenix Contact sells Iconics software.

1.6 INTERBUS Addressing

The process data registered in the INTERBUS system must be clearly assigned to an address position in the memory of a control or computer system. Therefore, address areas in the control system must be assigned to devices with input/output functions.

There are two methods for assigning address areas. These methods differ in simplicity and flexibility.

Addresses can be assigned either automatically (→ automatic addressing) or by the user, e.g., using CMD software (→ user-defined addressing).

For additional information on addressing and bit assignment in INTERBUS for your specific control or computer system, please refer to the data sheet DB GB IBS SYS ADDRESS Data Sheet, Part No. 90 00 99 0.

1.7 Conformance with EMC Directive 89/336/EEC

The following tables provide standard data. For different values please refer to the module-specific data sheets.

Noise Immunity Test According to EN 50082-2

Electrostatic discharge (ESD)	EN 61000-4-2/ IEC 61000-4-2	Criterion B 6 kV contact discharge 8 kV air discharge
Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	Criterion B Supply lines: 2 kV Signal/data lines: 2 kV
Surge voltage	EN 61000-4-5/ IEC 61000-4-5	Criterion B AC supply lines: 2.0 kV/4.0 kV (symmetrical/asymmetrical) DC supply lines: 0.5 kV/0.5 kV (symmetrical/asymmetrical) Signal lines: 1.0 kV/2.0 kV (symmetrical/asymmetrical)
Conducted interference	EN 61000-4-6 IEC 61000-4-6	Criterion A Test voltage 10 V

Noise Emission Test According to EN 50081-2

Noise emission of housing	EN 55011	Class A

Section 2

This section informs you about
– basic connection methods

2 INTERBUS Installation

2.1 Note

When preparing cable installation, the local conditions and the corresponding mounting regulations are very important. Cables can for example be installed in cable ducts or cable bridges.

A minimum distance between the cabling and possible sources of interference (e. g., machines, welding equipment, power cables) is defined in relevant regulations and standards. During planning and installation of the INTERBUS system these regulations and standards must be taken into account and observed.

Protect the bus lines from electric/magnetic interferences and mechanical strain.

Note the following guidelines for "Electromagnetic Compatibility" (EMC).

Mechanical strain

To keep mechanical danger low, follow these guidelines:

- Choose the correct cable type for each application (e.g., for indoor and outdoor installation, trailing chains), see "Technical Data of the Cable Types" on page B-1.
- Make sure the bending radius does not fall below a certain value, see "Technical Data of the Cable Types" on page B-1.
- Cables must not enter the shear area of moving machine parts.
- Do not install bus lines at right angles to driving paths and machine movements.
- Use cable ducts or cable bridges.

Interference

- Signal and power supply lines should not be installed in parallel. If necessary, metal isolating segments should be placed between the power supply and signal lines.
- Only use connectors with metal housings and connect as much of the shielding as possible to the housing.
- Refer to "Installing Bus Lines Between Buildings" on page 2-7 when grounding cables run between buildings.

– For the installation, all interlocks of the connectors (screws, cap nuts) must be firmly tightened to guarantee the best contact between shielding and ground. Before initial startup, the connection between ground and shielding must be checked for low-resistance continuity.

Routing of buses in control cabinets

– Install bus lines in separate cable ducts or separate cable bundles.
– Avoid the installation of bus lines parallel to power supply lines.
– Install bus lines with a minimum distance of 10 cm (3.937 in.) to power cables.

Routing of buses in buildings

– If possible, use metal cable hangers.
– Do not install bus lines together with or parallel to power supply lines.
– Separate bus lines on cable bridges or in cable ducts with isolating segments from the power supply lines.
– Install bus lines as far away as possible from interference sources, for example, motors and welding equipment.
– For long line connections, install an additional equipotential bonding line between the connection points.

Routing of buses outside buildings

– Install the bus lines in metal pipes that are grounded on both sides or in concrete cable ducts with continuous reinforcement.
– For long line connections, install an additional equipotential bonding line between the connection points.

2.1.1 Relevant Standards

For grounding, please observe the following standards and regulations.

– DIN VDE 0100
– DIN VDE 0185

Please also note "Relevant Standards" on page 1-5.

2.2 Installation Information

The modules can be mounted in two different ways:

– on a mounting rail
– directly on a mounting surface

Rail mounting

Information in this manual regarding rail mounting is based on standardized (EN 50022) mounting rails. The modules are snapped on grounded mounting rails with clamp angles and spring clamps.

Rail mounting is possible for the following modules:
Remote Terminals (RT), Smart Terminals (ST) and Configurable Terminals (CT).

In the Phoenix Contact Catalog the different types of rails are listed with the designation NS 35... and the corresponding order numbers.

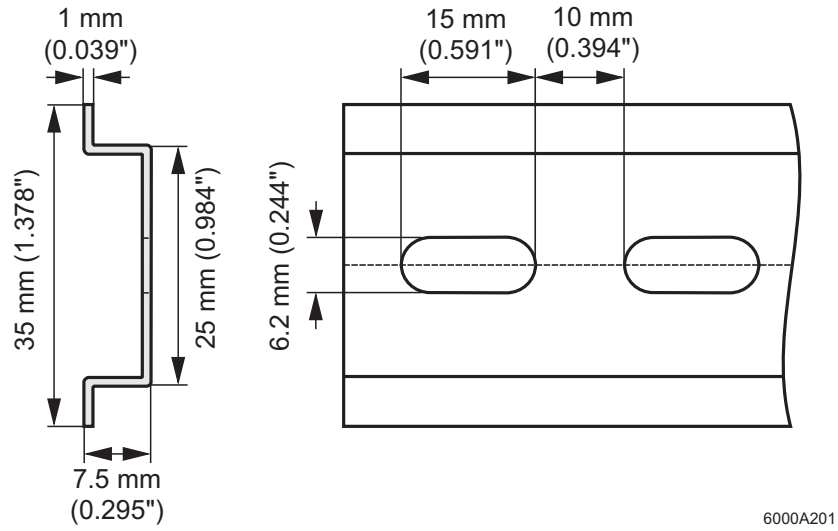


Figure 2-1 Standard mounting rail NS 35/7,5CU

Direct mounting

When direct mounting is used, the modules are fastened with screws to grounded mounting angles or mounting plates.

Direct mounting is possible for the following modules:
Motor starter, sensor/actuator boxes (SAB) and Remote Terminals (RT).

2.3 Grounding Concept

Grounding protects human beings and machines from dangerous voltages. To avoid these dangers, a correct installation, taking the local conditions into account, is vital.

All INTERBUS devices must be grounded to avoid possible signal interferences.

A wire of at least 2.5 mm^2 (14 AWG) must be used for grounding (spring-clamp terminal 1.5 mm^2 (16 AWG). For certain device types, larger wire cross sections may be necessary.

The grounding method depends on the mounting of the modules.

Before a module is installed on a mounting rail, the mounting rail must be connected with protective earth ground using grounding terminals. In most cases the module is connected to protective earth ground using a metal clip on the rear of the module.

Other modules are installed on a mounting surface (direct mounting). The PE connection of the housing can be achieved using a mounting screw on a grounded mounting surface or an outside grounding connection.

2.4 Shielding Concept

Please note the following:

- Ensure a large surface connection of the shield under strain relief or install a shield sleeve.
- Ensure good contact between connector and module (screw connector tight).
- Do not damage or squeeze any wires. Do not strip off the wires too far.
- Use metal-coated or metal connectors with electrical connection to strain relief.
- Ensure a clean wire connection.
- Avoid cold junctions.
- Ground the modules.

2.5 Installing Bus Lines Between Buildings

Overvoltages

Overvoltages result from switching operations, electrostatic discharges and lightning discharges. Overvoltages inject inductively, capacitively or galvanically into the electrical lines for power supply, measured value transmission and data transmission. In this way, surge voltages reach supply units and interfaces of systems and devices.

Grounding cable shielding

Ground the cable shielding (Figure 2-2; 2) directly after it has been installed in the building to avoid overvoltages. The cable shielding must have a diameter that meets all applicable standards.

Equipotential bonding line

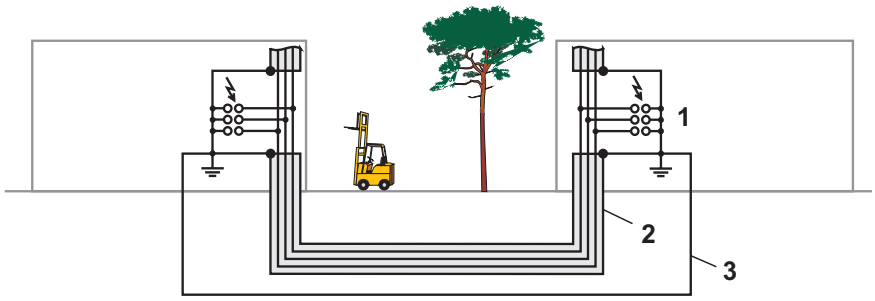
Install an additional equipotential bonding line between the grounding points of buildings (Figure 2-2; 3), that preferably is designed as

- a metal reinforced concrete channel
- an additional grounding cable
- a metal pipe

Surge voltage protection devices

Phoenix Contact recommends that all cable wires are connected with surge voltage protection devices (Figure 2-2; 1) to protect the modules from overvoltages.

Make sure you follow the national and international regulations when installing the surge voltage protection devices.



6000A202

Figure 2-2 Surge voltage protection measures

1 Surge voltage protection devices
2 Cable shielding
3 Equipotential bonding line

2.6 Interference Suppression Measures

Phoenix Contact recommends connecting relay coils and motor coils to an RC element, to protect the modules from interference. Depending on the application, the delay time of the relay can be increased by approximately 1 ms.

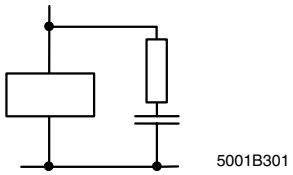


Figure 2-3 Relay coil with RC element

For the sizing of the RC element the following values are recommended:

R = 100 – 200 Ω

C = 220 – 470 nF

2.7 Power Supply of Bus Terminal Modules (BK Modules)

The BK module supplies communications power to the module electronics of the connected modules. If this communications power is switched off, the bus stops.

The power supply of the sensors and actuators should be installed and protected independently of the power supply of the INTERBUS module electronics. This way INTERBUS continues to run even if some I/O devices are switched off.

When using an emergency stop circuit, only the power supply of the actuators should be connected to the emergency stop circuit. Errors can then be detected with the sensors in the emergency stop state.

2.8 Connection of Digital Sensors and Actuators

Most of the digital I/O modules of the INTERBUS product families enable the connection of sensors and actuators in 1-wire, 2-wire, 3-wire or 4-wire technology.

In the following, these connection methods are described in general terms. The explanation of the connection methods is independent of the terminal assignment of a specific product family.

2.8.1 Terms Used

N-wire technology

The term "n-wire technology" means: "n" wires are connected to the input or output module.

4-wire technology means for example, that the following signals/cables can be connected to an input module:

– Sensor signal (IN)
– Sensor supply (U_L)
– Sensor ground (⊥)
– Grounding or shielding of the sensor

2.8.2 Digital Inputs

1-wire technology

1-wire technology means that the sensor and module are supplied from the same voltage source. Therefore only one wire is necessary between the sensor and the module.

The I/O terminal strips of the modules have one terminal point per input channel:

– For the connection of a digital input signal (= IN)

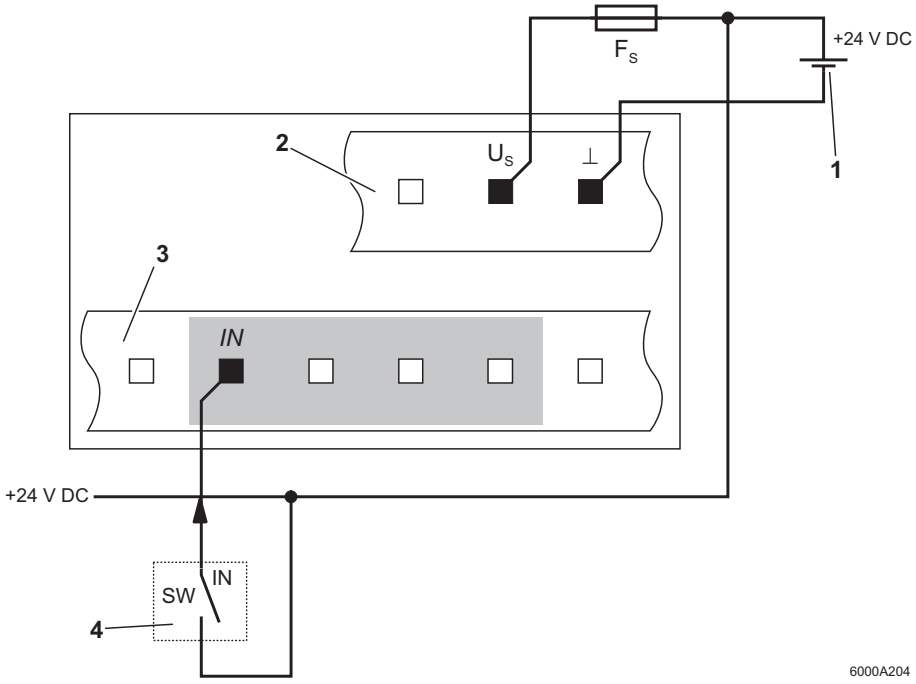


Figure 2-4 Digital inputs: 1-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for the I/O inputs
4 Sensor (here: switch)

Figure 2-4 shows in a schematic way the detection of a sensor signal (4). The SW switch provides the input signal. The input (IN) indicates "switch closed/open".

2-wire technology

Connecting 2-wire sensors to digital input modules.

The I/O terminal strips of the modules have one terminal point per input channel:

– For the connection of a digital input signal (= IN)
– For the sensor supply (U_L)

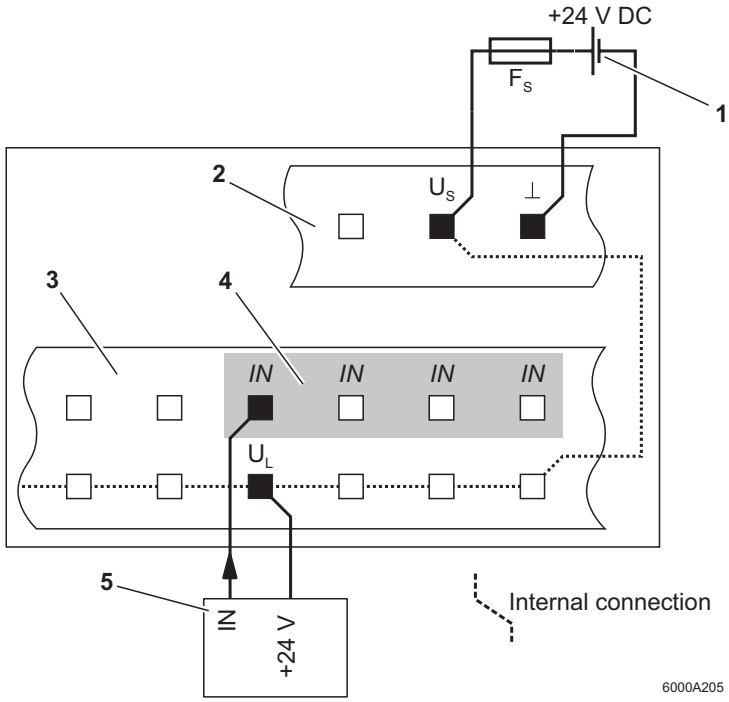


Figure 2-5 Digital inputs: 2-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for I/O inputs (IN) and sensor voltage (U_L)
4 I/O inputs of an isolated group
5 2-wire sensor

Figure 2-5 shows the connection of a 2-wire sensor (5). The sensor signal is led to the input terminal (IN). Sensor power is supplied through the sensor voltage U_L.

3-wire technology

Connecting 3-wire sensors to digital input modules.

The I/O terminal strips of the modules have one terminal point per input channel:

– For the connection of a digital input signal (= IN)
– For the sensor supply (= U_L)
– For the ground connection of the sensor supply (= ⊥)

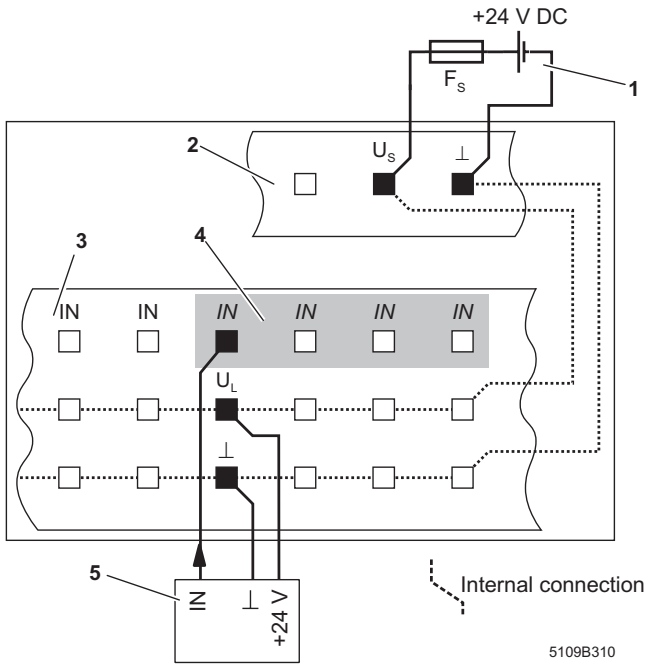


Figure 2-6 Digital inputs: 3-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for I/O inputs (IN), sensor voltage (U_L) and GND
4 I/O inputs of an isolated group
5 3-wire sensor

Figure 2-6 shows the connection of a 3-wire sensor (5). The sensor signal is led to the input terminal (IN). The 3-wire sensor power is supplied th-rough the terminal points U_L and ⊥.

4-wire technology

Connecting 4-wire sensors to digital input modules.

The I/O terminal strips of the modules have one terminal point per input channel:

– For the connection of a digital input signal (= IN)
– For the sensor supply (= U_L)
– For the ground connection of the sensor supply (= ⊥)
– For the grounding of the sensor (= FE)

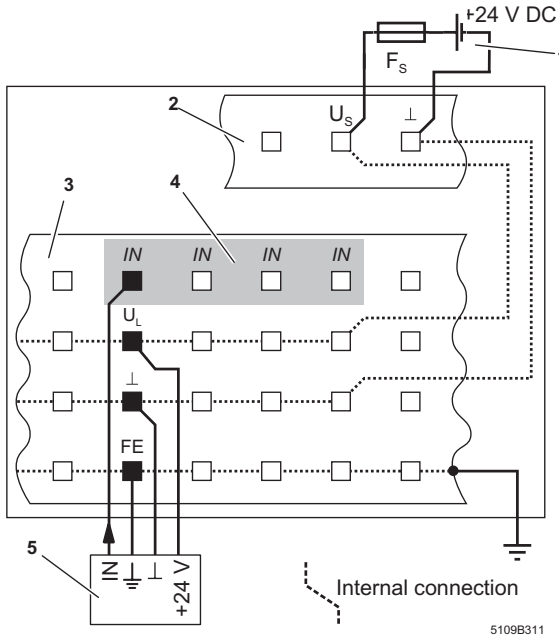


Figure 2-7 Digital inputs: 4-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for I/O inputs (IN), sensor voltage (U_L), GND and FE
4 I/O inputs of an isolated group
5 4-wire sensor (3-wire sensor with shielding)

Figure 2-7 shows the connection of a shielded 3-wire sensor (5). The sensor signal is led to the input terminal IN (4). The sensor power is supplied through the terminal points U_L and ⊥. The sensor is grounded through the FE (functional earth ground) terminal point.

2.8.3 Digital Outputs

1-wire technology

1-wire technology means that the actuator voltage and the supply voltage have the same reference ground. Therefore, only one wire is necessary between the actuator and the module.

The I/O terminal strip of the module has one terminal point per output channel:

– To pick off a digital output signal (= OUT)

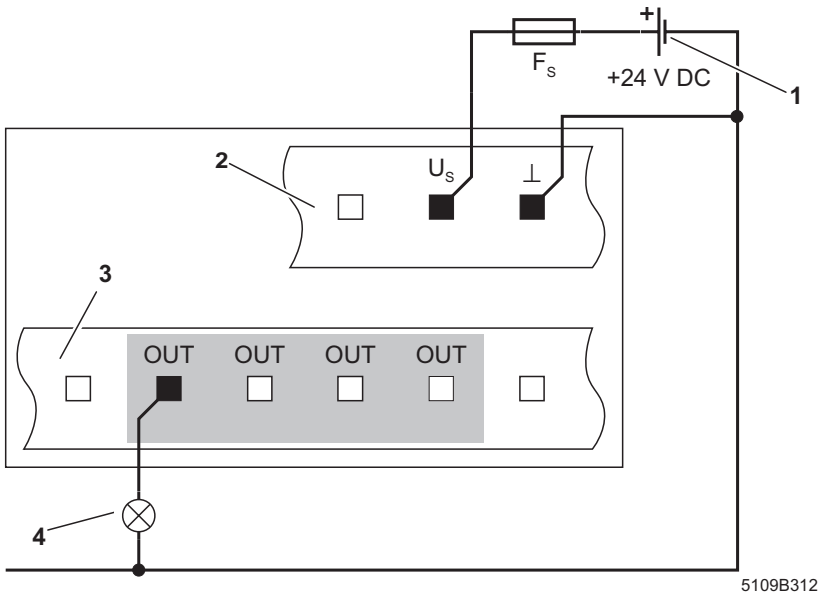


Figure 2-8 Digital outputs: 1-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for the I/O outputs (OUT)
4 Actuator (here: lamp)

Figure 2-8 shows the connection of an actuator (4) to the I/O terminal strip of a digital output module. The load (lamp) is directly switched through output OUT.

The maximum current carrying capacity of the output must not be exceeded.

2-wire technology

Connecting actuators to digital output modules.

The I/O terminal strips of the module have one terminal point per output channel:

– To pick off a digital output signal (= OUT)
– For the reference potential (= ⊥) of the output channel

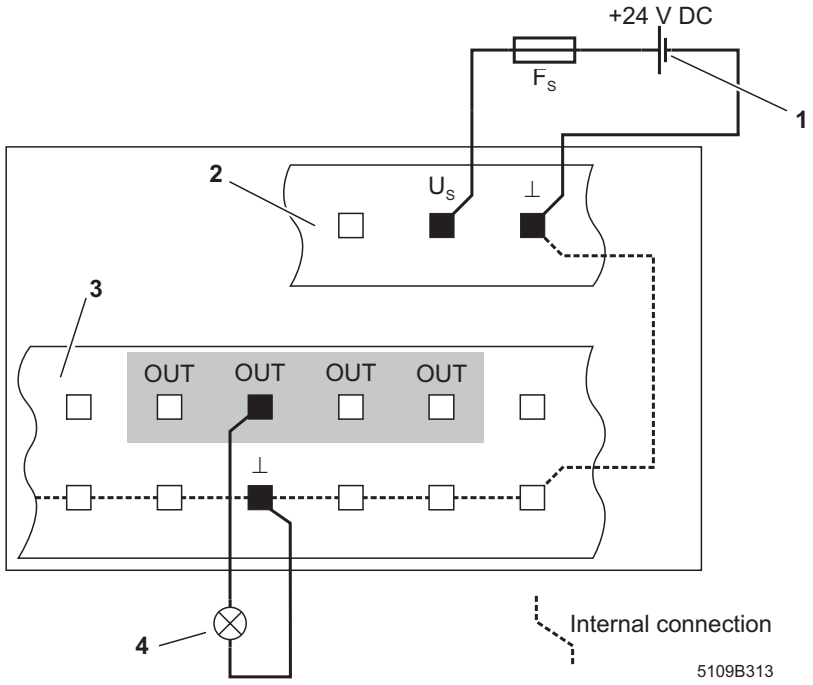


Figure 2-9 Digital outputs: 2-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for the I/O outputs (OUT)
4 Actuator (here: lamp)

Figure 2-9 shows the connection of an actuator (4) to the I/O terminal strip of a digital output module. The actuator power is supplied through output OUT. The load (lamp) is directly switched through the output.

The maximum current carrying capacity of the output must not be exceeded.

3-wire technology

Connecting shielded actuators to digital output modules.

The I/O terminal strip of the module has one terminal point per output channel:

– To pick off a digital output signal (= OUT)
– For the reference potential (= ⊥) of the output channel
– For the grounding of the actuator (= FE)

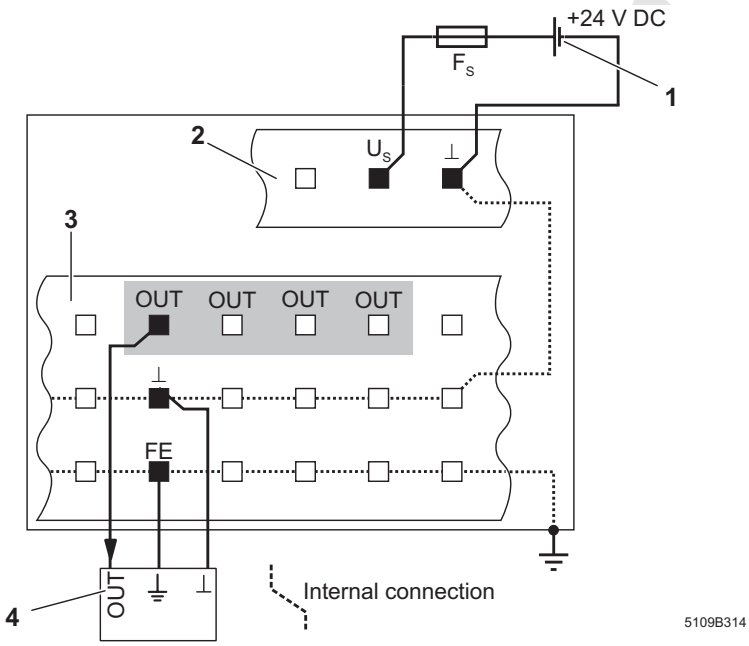


Figure 2-10 Digital outputs: 3-wire technology

1 Power supply
2 Terminal strip for the I/O supply
3 Terminal strip for the I/O outputs (OUT)
4 Shielded actuator

Figure 2-10 shows the connection of a shielded actuator (4) to the I/O terminal strip of a digital output module. The actuator power is supplied through output OUT. The load is directly switched through output OUT.

The maximum current carrying capacity of the output must not be exceeded.

2.9 Assembling Standard Connections

2.9.1 Tools

The following tools are necessary for cable assembly. For the different connection types not all tools are used, so in the corresponding installation descriptions the necessary tools are mentioned.

Copper cable

- Stripping tool, adjustable
  Order Designation KAMES LWL, Order No. 12 06 14 6
- Diagonal cutter
  Order Designation S 165, Order No. 12 01 91 8
- Cable stripper, adjustable (min. 3 to 6 mm [0.118 in. to 0.236 in.])
  Order Designation QUICK-WIREFOX 6, Order No. 12 04 38 4
- Soldering iron or soldering station with flat tip (1.6 mm [0.063 in.]) and tin-lead solder (LsN 60)
- Screwdriver (2.5 mm [0.098 in.])
  Order Designation SZF 0 – 0,4 x 2,5, Order No. 12 04 50 4
- Screwdriver (3.5 mm [0.138 in.])
  Order Designation SZF 1 – 0,6 x 3,5, Order No. 12 04 51 7
- Wrench (17 mm and 21 mm [0.669 in. and 0.827 in.])
- IP 65 assembly wrench,
  Order Designation IBS CCO MT, Order No. 27 58 32 1
- Crimping pliers
  Order Designation HC-ZA 15D, Order No. 17 72 79 3
- Crimping pliers for ferrules (0.5 to 2.5 mm^2 [20 to 14 AWG])
  Order Designation CRIMPFOX UD 6, Order No. 12 04 43 6
- Continuity tester
  Order Designation PT 1, Order No. 12 02 40 9

Optical fiber (polymer fiber)

- Stripping tool, adjustable
  Order Designation KAMES LWL, Order No. 12 06 14 6
- Stripping pliers
  Order Designation PSM-FO-STRIP, Order No. 27 61 37 6
- Assembly case for polymer fibers
  Order Designation PSM-POF-KONFTOOL, Order No. 27 44 13 1
- Optical fiber measuring device, set
  Order Designation PSM-FO-POWERMETER, Order No. 27 99 53 9

2.9.2 Assembling D-SUB Connectors

Type: 9-pos. D-SUB connector, male and female, mechanical protection against polarity reversal

Order Designation: IBS DSUB 9/L (solder connection), Order No. 27 58 47 3
IBS DSUB 9/C (crimp connection), Order No. 27 58 48 6

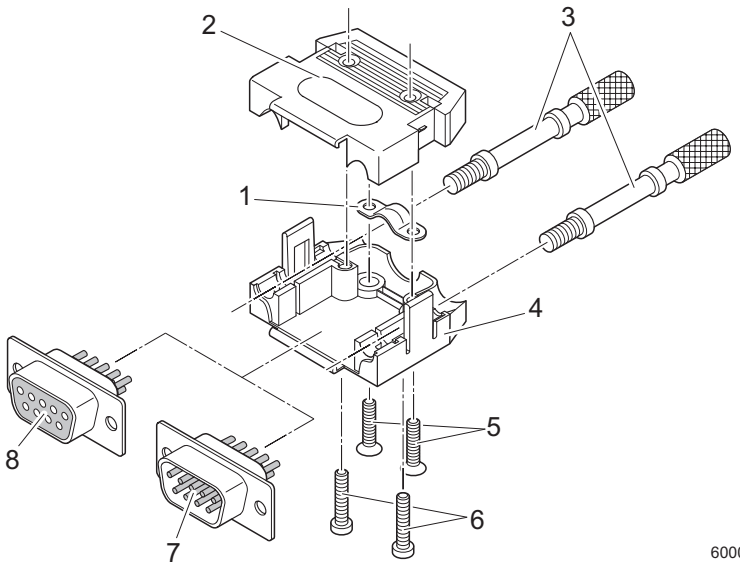


Figure 2-11 Components of the D-SUB connector, 9-pos.

1 Shield clamp/strain relief
2 Upper part of the housing
3 Interlocking screws
4 Lower part of the housing
5 Screws for the shield clamp
6 Screws for the housing
7 Contact housing with solder contacts (male connector)
8 Contact housing with solder contacts (female connector)

Assembly steps

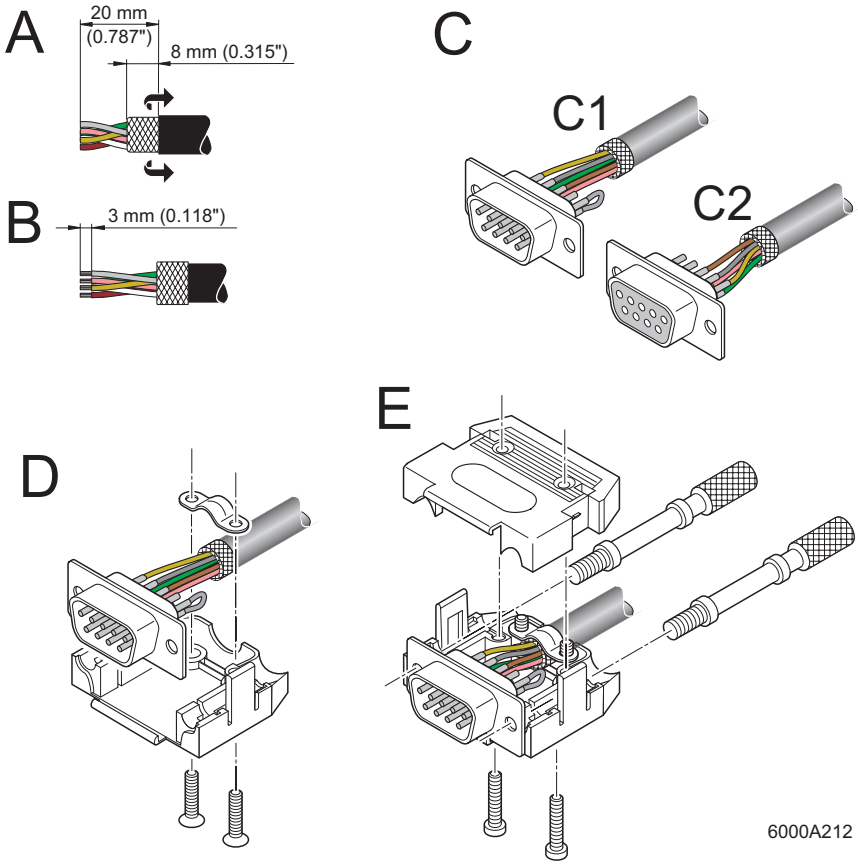


Figure 2-12 Assembling D-SUB connectors

- Strip 20 mm (0.787 in.) off the sheath (A).
- Shorten the shield to 8 mm (0.315 in.) (A).
- Fold the shielding uniformly back over the sheath (A).
- Strip 3 mm (0.118 in.) off the wires. Cut the white wire off (B).
- Solder the wires to the contacts or crimp the wires with crimping pliers (C).
  The contacts of a connector in crimp design must be inserted into the contact housing (for pin assignment, see Figure 2-13 on page 2-22).

As much of the shielding as possible must be in contact with the shield clamp and the lower part of the housing to ensure optimum shielding. The shield clamp also causes strain relief.

- Place the cables with their contact housing in the slot of the lower part of the housing and connect the shielding of the cable with the shield clamp of the housing and screw it tight (D).
  Screw the shield clamp tight using the two countersunk screws.

The wires must not be squeezed between the housing parts.

- Insert the interlocking screws into the drill holes of the contact housing and place them into the guideways of the lower part of the housing. Snap the upper part of the housing on the lower part and fasten the housing pieces together using the two socket-head cap screws (E).

Pin assignment

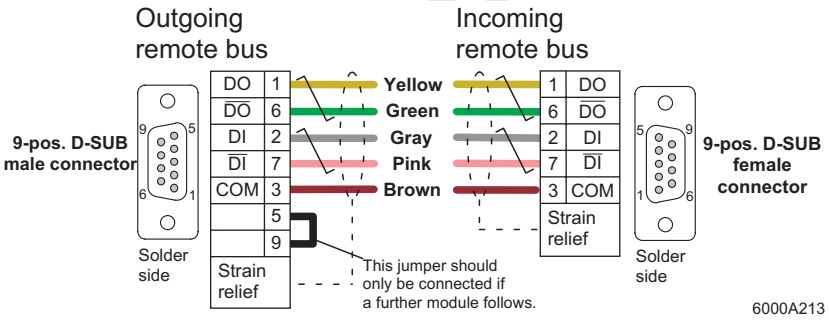


Figure 2-13 D-SUB connector pin assignment

The contacts 5 and 9 are only jumpered in the outgoing connector.

2.9.3 Assembling SUBCON Connectors

Type:	9-pos. D-SUB connector, male and female, mechanical protection against polarity reversal
Order Designation:	SUBCON 9/F-SH (female connector, screw-clamp connection), Order No. 27 61 49 9 SUBCON 9/M-SH (male connector, screw-clamp connection), Order No. 27 61 50 9

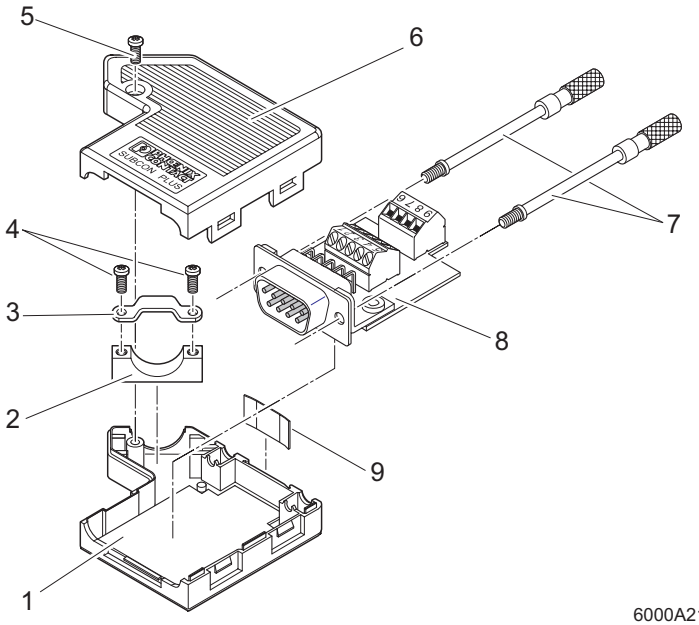


Figure 2-14 Components of the SUBCON connector, (9-pos.)

1 Lower part of the housing
2 Lower part of the shield clamp/strain relief
3 Upper part of the shield clamp/strain relief
4 Screws for the shield clamp
5 Screw for the housing
6 Upper part of the housing
7 Interlocking screws
8 Contact insert
9 Labeling field

Assembly steps

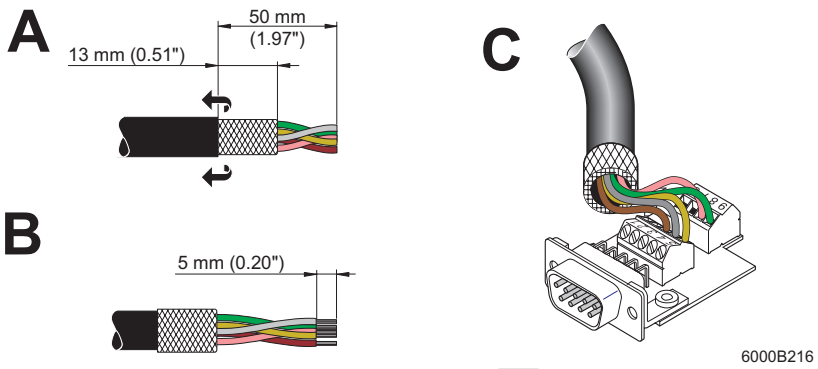


Figure 2-15 Assembling SUBCON connectors (1)

- Strip 50 mm (1.969 in.) off the sheath (A).
- Shorten the shield to 10 mm (0.394 in.) (A).
- Fold the shielding uniformly back over the cable sheath (B).
- Strip 5 mm (0.197 in.) off the wires. Cut the white wire off (B).
- Crimp the ferrules onto the stripped off wires. Use only small ferrules or ferrules without bending protection so that the wires are not damaged.
- Push the wires into the screw-clamp terminals of the connector and tighten the connection with a screwdriver (C).

Pin assignment

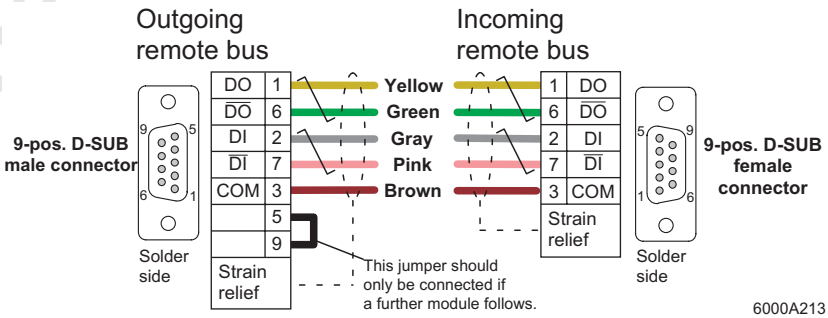


Figure 2-16 SUBCON connector pin assignment

The contacts 5 and 9 are only jumpered in the outgoing connector.

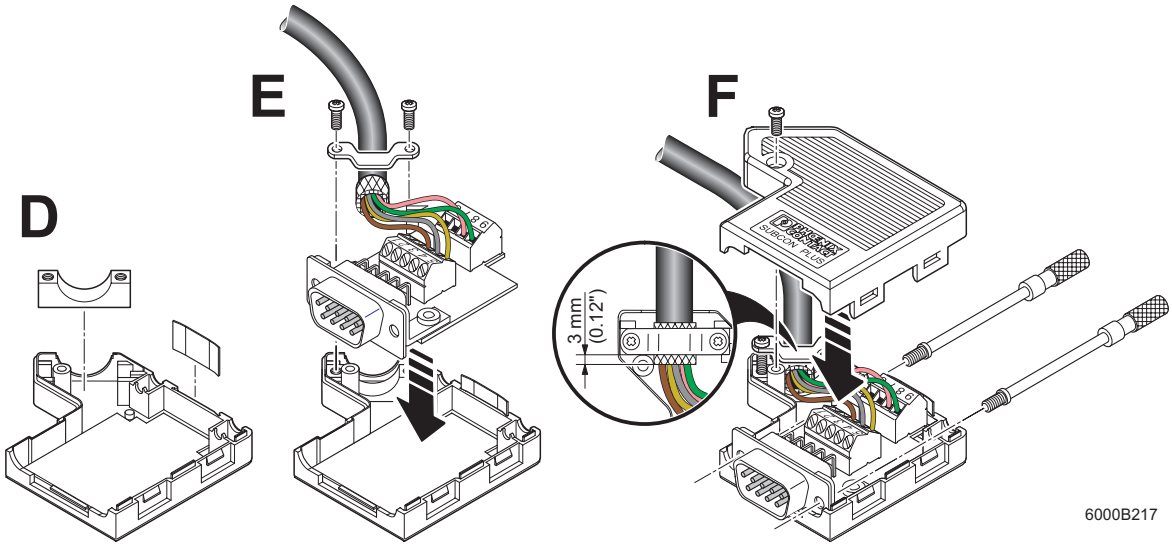


Figure 2-17 Assembling SUBCON connectors (2)

The shielding must have uniform contact with the shield clamp and the lower part of the housing to ensure optimum shielding. The shield clamp also causes strain relief.

- Insert the lower part of the shield clamp and the labeling field into the lower part of the housing (D).

The wires must not be squeezed between the housing parts.

- Place the cables with their contact insert in the slot of the lower part of the housing. Connect the shielding of the cable with the upper part of the shield clamp of the housing (E).

For standard INTERBUS cables the upper part of the shield clamp must be turned upside down so that the cable cannot be pulled out of the strain relief (see Figure 2-25).

Cable type	Order No.	Shield clamp position	
IBS RBC METER-T	28 06 28 6	Turned upside down	
IBS RBC METER/F-T	27 23 12 3	Turned upside down	
IBS RBC METER/E-T	27 23 14 9	Not turned	

Ensure that the shielding projects at least 3 mm (0.118 in.) over the shield clamp (F).

- Only then use the two screws to screw the shield clamp tight.
- Snap the upper part of the housing on the lower part and secure the connection by screwing it tight (F).

2.9.4 Assembling M12 Connectors

Type:	M12 connector with mechanical protection against polarity reversal, mechanical interlock through cap nut, IP 67 protection when the connector is inserted. Twelve different connector types are available: 4-pos./5-pos., with straight and angled connector, with knurled plastic or metal head (PG7 or PG9 gland type) and two-pin-plug (PG 11 gland type).
Order Designation:	SACC-M12MS-5CON-PG7 (5-pos., straight connector, with knurled plastic head, PG7), Order No. 16 62 25 6 SACC-M12MR-5CON-PG7 (5-pos., angled connector, with knurled plastic head, PG7), Order No. 16 62 26 9 Please refer to the Phoenix Contact Catalog for further ordering data.

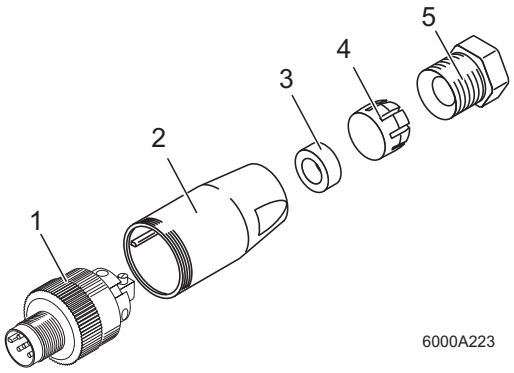


Figure 2-18 Components of the M12 connector

1 Contact insert
2 Protective cap
3 Grommet
4 Compression ring
5 Cap nut

Assembly steps

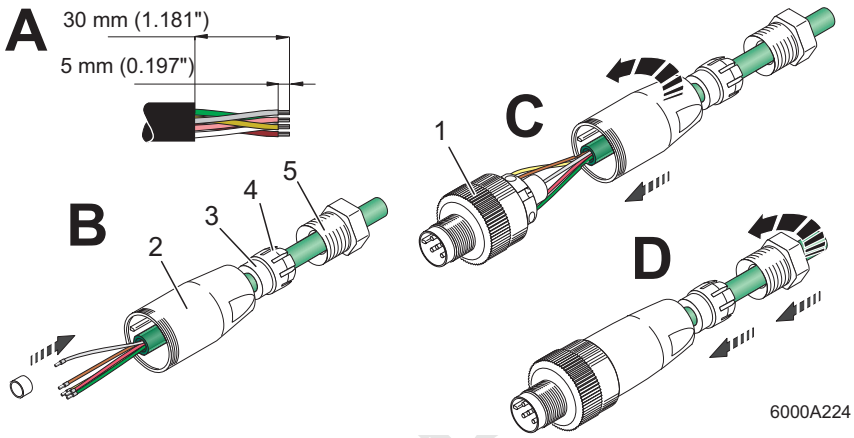


Figure 2-19 Assembling M12 connectors

- Strip approx. 30 mm (1.181 in.) off the outer cable sheath (A).
- Strip 5 mm (0.197 in.) off the wires.
- Fit ferrules at the ends.
- Push grommet into compression ring. Then push the protective cap (2), grommet (3), compression ring/grommet onto the prepared cable (B).
- Push the shrink tube for the functional ground (pin 5) over the corresponding wire.
- Push the wires into the pins of the contact insert (1) and screw into place. The shrink tube is thus pushed over the central contact. For the pin assignment please refer to the corresponding data sheets (C).
- Push protective cap (2) into the contact insert (1).
- Push compression ring with the grommet into the protective cap and screw the cap nut into the protective cap (D).

Section 3

This section informs you about

– basic INTERBUS configuration

3 INTERBUS Project Planning

The project planning of an INTERBUS system starts with the number of process input/output points, possible special functions (counting, V.24 transmission, motor control, etc.) and the degree(s) of protection given by the ambient conditions.

The hierarchy of the following criteria determines the selection of the INTERBUS devices.

Selection criteria

1. Degree of protection required (e.g., IP 20, IP 65, IP 67)
2. Product group (local bus or remote bus device). When selecting local bus devices (e.g., Smart Terminals) keep in mind that for the connection to the remote bus one bus terminal module (BK module) per device group is needed.
   Remote bus devices (e.g., Configurable Terminals, Remote Terminals, Sensor/Actuator Boxes, motor starters) can be operated without preconnected BK module.
3. Signal type and direction (digital, analog, input and/or output)
4. Number and combination of the input and output connections available

In each product group the following criteria must be maintained within a subsection:

– **Maximum number of devices** (see „Overview of the Dimensioning of Subsections“ auf Seite 1-13)
– **Current carrying capacity of the BK module** (see „INTERBUS Devices for Dimensioning the Bus Structure“ auf Seite 3-11)
– **Maximum length of the entire section and subsections** (see „Overview of the Dimensioning of Subsections“ auf Seite 1-13)

Selecting the Controller Board

Look up the suitable controller board for your control system/computer in the Phoenix Contact catalog.

Controller boards containing "/I" in their designation are electrically isolated from the control system/computer.

Selecting/Dimensioning the Process Memory

The necessary memory requirements of the INTERBUS I/O data in the control system are defined in the data sheet "IBS Teilnehmerliste (device list)" (Part No. 92 70 53 0).

Configuring the Application Program

When planning the system you can complete the first steps for configuring the application program. You can, for example, draw up device lists for PLCs or plans for the memory assignment and define the variables (bit, byte and word formats).

Use the data sheet "IBS Teilnehmerliste (device list)" (Part No. 92 70 53 0).

3.1 Bus Cable Selection

Use only cables from Phoenix Contact or cables with the following technical specifications.

Deviations from the mechanical specifications are permissible for special applications if the electrical features are maintained.

The cables must be connected in such a way that the indicated electrical data is transmitted correctly.

Special attention must be paid to the installation of the shielding. The shielding must be connected in such a way that the cable diameter is not reduced. The wires must be covered with as much of the braided shield as possible.

The wire pairs must be twisted up to the connection contacts.

Two cables should not be connected with each other as losses can be caused by reflections at the connection point. The shielding effect could also deteriorate. This is especially the case if different cable types are connected.

3.1.1 Remote Bus Cables

Table 3-1 Specifications for remote bus cables*

	IBS RBC METER-T	IBS RBC METER/F-T	IBS RBC METER/E-T
Order No.	28 06 28 6	27 23 12 3	27 23 14 9
Application	For fixed wiring	For highly flexible applications	For permanent indoor and outdoor installation (even underground)
Structure	3 x 2, twisted-pair, with common shielding (tinned copper braided shield)		
			Additional reinforced PVC outer sheath
Color coding of the wires	DIN 47100 Pink, gray, yellow, green, white, brown (data lines)		
Cable diameter	0.22 mm² (24 AWG)	0.25 mm² (24 AWG)	0.22 mm² (24 AWG)
Outside diameter	7.2 mm (0.283 in.)	8.1 mm (0.319 in.)	9.3 mm (0.366 in.)
Outer cable sheath	Green (RAL 6017), flame-retardant	Green (RAL 6017), flame-retardant halogen-free	Black (RAL 9005), UV-resistant
Operating temperature	Fixed -30°C to +70°C (-22°F to +158°F)	Fixed -30°C to +70°C (-22°F to +158°F) Flexible -5°C to +70°C (+23°F to +158°F)	Fixed -30°C to +70°C (-22°F to +158°F)
Weight	7.2 kg/100 m (328 ft.)	7.4 kg/100 m (328 ft.)	9.4 kg/100 m (328 ft.)
Bending radius	Fixed at least 58 mm (2.283 in.)	Flexible at least 122 mm (4.803 in.)	Fixed at least 75 mm (2.953 in.)
Operating capacity	60 nF/km at 800 Hz, maximum		
Test voltage wire-wire	U_{rms} = 1500 V		
Conductor resistance	186 Ω/km, maximum (loop)	159.8 Ω/km, maximum (loop)	186 Ω/km, maximum (loop)

Table 3-1 Specifications for remote bus cables*

	IBS RBC METER-T	IBS RBC METER/F-T	IBS RBC METER/E-T
Surge impedance	100 Ω		
Isolation resistance (after testing the dielectric strength)	At least 150 MΩ/km		
Characteristic impedance	120 Ω ±20% at f = 0.064 MHz 100 Ω ±15% at f > 1 MHz		
Environmental compatibility	Free of substances which would hinder coating with paint or varnish (according to VW specification)		
INTERBUS certification number	112	117	116

* These are typical values at 20°C (68°F) ambient temperature.

3.1.2 Installation Remote Bus Cables

Table 3-2 Specifications for installation remote bus cables*

	IBS INBC METER	IBS INBC METER/S	IBS INBC METER/E
Order No.	27 23 13 6	27 59 87 0	27 23 15 2
Application	For fixed wiring Partially welding-resistant	For highly flexible applications Partially welding-resistant	For permanent indoor and outdoor installation (even underground)
	With additional wires for the power supply		
Structure	3 x 2, twisted-pair (data), 3 single wires (power), with common shielding (braided shield consisting of high-grade steel)		
			Additional reinforced PVC outer sheath
Color coding of the wires	DIN 47100 Pink, gray, yellow, green, white, brown (data) Blue, red, green/yellow (power)		
Cable diameter	0.22 mm² [24 AWG] (data) 1.0 mm² [18 AWG] (power)	0.25 mm² [24 AWG] (data) 1.0 mm² [18 AWG] (power)	0.22 mm² [24 AWG] (data) 1.0 mm² [18 AWG] (power)
Outside diameter	7.9 mm (0.311 in.)	7.9 mm (0.311 in.)	9.4 mm (0.370 in.)
Outer cable sheath	Green (RAL 6017), flame-retardant	Green (RAL 6017), flame-retardant halogen-free	Black (RAL 9005), UV resistant
Operating temperature	Fixed -30°C to +70°C (-22°F to +158°F)	Fixed -30°C to +70°C (-22°F to +158°F) Flexible -5°C to +70°C (+23°F to +158°F)	Fixed -30°C to +70°C (-22°F to +158°F)
Weight	8.5 kg/100 m (328 ft.)	9.5 kg/100 m (328 ft.)	12.8 kg/100 m (328 ft.)
Bending radius	Fixed at least 64 mm (2.520 in.)	Flexible at least 119 mm (4.685 in.)	Fixed at least 76 mm (2.992 in.)
Operating capacity	65 nF/km at 800 Hz, maximum		

Table 3-2 Specifications for installation remote bus cables*

	IBS INBC METER	IBS INBC METER/S	IBS INBC METER/E
Test voltage wire-wire	U_{rms} = 1500 V		
Conductor resistance	186 Ω/km, maximum (loop)	159.8 Ω/km, maximum (loop)	186 Ω/km, maximum (loop)
Surge impedance	100 Ω		
Isolation resistance (after testing the dielectric strength)	At least 150 MΩ/km		
Characteristic impedance	120 Ω ±20% at f = 0.064 MHz 100 Ω ±15% at f > 1 MHz		
Environmental compatibility	Free of substances which would hinder coating with paint or varnish (according to VW specification)		
INTERBUS certification number	115	114	113

* These are typical values at 20°C (68°F) ambient temperature.

3.1.3 Selecting Connectors

Table 3-3 Connector selection

Cable Type	Designation	Order No.	Connector	Order No.
Remote bus				
Standard	IBS RBC METER-T	28 06 28 6	9-pos. D-SUB:	
Highly flexible	IBS RBC METER/F-T	27 23 12 3	IBS DSUB 9/L (solder connect.)	27 58 47 3
Underground installation	IBS RBC METER/E-T	27 23 14 9	IBS DSUB 9/C (crimp connect.)	27 58 48 6
			IBS SUBCON 9/F-SH	27 61 49 9
			IBS SUBCON 9/M-SH	27 61 50 9
			IP 65 circular connector	
			IBS CCO-R/L	27 59 88 3
			IBS CCO-PSM/L (power)	27 59 90 6
			IBS CCO-PSF/L (power)	27 80 87 8
Installation remote bus				
Standard	IBS INBC METER	27 23 13 6	IP 65 circular connector	
Highly flexible	IBS INBC-METER/S	27 59 87 0	IBS CCO-R/L (bus)	27 59 88 3
Underground installation	IBS INBC METER/E	27 23 15 2	IBS CCO-PSM/L (power)	27 59 90 6
			IBS CCO-PSF/L (power)	27 80 87 8

3.2 INTERBUS Devices for Dimensioning the Bus Structure

ST Modules (Smart Terminals)	Current Output/ Consumption (mA)	Connection Type IN/OUT	Cable Type
Bus Terminal Modules (BK)	Current output*		
IBS ST (ZF) 24 BK DIO 8/8/3-LK	500	F-SMA/F-SMA	Fiber optic
IBS ST (ZF) 24 BK DIO 8/8/3-T	500	9-pos. D-SUB/9-pos. D-SUB	Remote bus
IBS ST (ZF) 24 BK LB-T	800	9-pos. D-SUB/9-pos. D-SUB Local bus branch: 15-pos. D-SUB	Remote bus
IBS ST (ZF) 24 BK RB-LK DIO 8/8/3-LK	500	F-SMA/F-SMA Remote bus branch: F-SMA	Fiber optic
IBS ST (ZF) 24 BK-RB-T DIO 8/8/3-LK	500	F-SMA/F-SMA Remote bus branch: 9-pos. D-SUB	Fiber optic Remote bus
IBS ST (ZF) 24 BK RB-T	800	9-pos. D-SUB/9-pos. D-SUB Local bus: ST connector Remote bus branch: 9-pos. D-SUB	Remote bus ST cable
IBS ST 24 BK-FT-T	(See data sheet)		
IBS ST (ZF) 24 BK-LK	800	F-SMA/F-SMA	Fiber optic
IBS ST (ZF) 24 BK-T	800	9-pos. D-SUB/9-pos. D-SUB	Remote bus
IBS ST (ZF) 24 BKM-LK	500	F-SMA/F-SMA	Fiber optic
IBS ST (ZF) 24 BKM-T	500	8-pos. MINI-COMBICON/ 8-pos. MINI-COMBICON	Remote bus
Analog Inputs	Current Consumption†		
IB ST (ZF) 24 AI 4/BP	110	ST/ST	ST cable
IB ST (ZF) 24 AI 4/I	65, max. 100		
IB ST (ZF) 24 AI 4/SF	120		
IB ST (ZF) 24 AI 4/SF4	120		
IB ST (ZF) 24 BAI 2/BP	140		
IB ST (ZF) 24 BAI 2/SF	140		
IB ST (ZF) 24 BAI 8/I	120		
IB ST (ZF) 24 BAI 8/U	120		
IB ST (ZF) 24 PT100 4/4	85		
IB ST 24 UTH 8	110		
Analog Outputs	Current consumption†		
IB ST (ZF) 24 AO 4/BP	100, max. 130	ST/ST	ST cable
IB ST (ZF) 24 AO 4/SF	100, max. 130		
IB ST (ZF) 24 AO 4/SF4	100, max. 130		
IB ST (ZF) 24 BAO 8/U	100, max. 120		
IB ST (ZF) 24 BAO 8/U-8B	100, max. 120		

ST Modules (Smart Terminals)	Current Output/ Consumption (mA)	Connection Type IN/OUT	Cable Type
Digital Inputs	Current Consumption†		
IB ST (ZF) 24 BDI 8/4	Max. 50	ST/ST	ST cable
IB ST (ZF) 24 BDI 16/4	Max. 100		
IB ST (ZF) 24 DI 16/4	Max. 100		
IB ST (ZF) 24 DI 32/2	Max. 100		
IB ST (ZF) 120 DI 16/3	Max. 100		
IB ST (ZF) 230 DI 16/3	Max. 100		
Digital Outputs	Current Consumption†		
IB ST (ZF) 24 BDO 8/3	Max. 50	ST/ST	ST cable
IB ST (ZF) 24 BDO 16/3-250	Max. 100		
IB ST (ZF) 24 BDO 16/3-500	Max. 100		
IB ST (ZF) 24 BDO 32/2	Max. 100		
IB ST (ZF) 24 DO 8/3-2A	Max. 50		
IB ST (ZF) 24 DO 16/3	Max. 100		
IB ST (ZF) 24 DO 16 R/S	Max. 100		
IB ST (ZF) 24 DO 32/2	Max. 100		
IB ST (ZF) 120/230 DO 8/3-1A	Max. 100		
Digital Inputs/Outputs	Current Consumption†		
IB ST ASI DIO	220	ST/ST (ASI)	ST cable
IB ST (ZF) 24 DIO 8/8/3-2A	Max. 100	ST/ST	
IB ST (ZF) 24 DIO 8/8R/3	50, max. 100		
Special Function Modules	Current Consumption†		
IB ST (ZF) 24 CNT	200	ST/ST	ST cable
IB ST (ZF) 24 INC/2	200		
IB ST (ZF) 24 PT100 4/4	85		
IB ST 24 UTH 8	110		
IB ST 24 V.24	130		

* Permissible total current consumption of all I/O modules

† Typical current consumption from the ST local bus

RT Modules (Remote Terminals)	Current Output/ Consumption (mA)	Connection Type IN/OUT	Cable Type
IBS RT 24 AI 8-T	Typ. 100/max. 150	9-pos. D-SUB/9-pos. D-SUB	Remote bus
IBS RT 24 AIO 4/2-T	Typ. 150/max. 280		
IBS RT 24 AO 4-T	Max. 280		
IBS RT 24 BK RB-T	200	9-pos. D-SUB/9-pos. D-SUB Remote bus branch: 9-pos. D-SUB	
IBS RT 24 DI 16-T	100	9-pos. D-SUB/9-pos. D-SUB	
IBS RT 24 DI 32-T	100		
IBS RT 24 DIO 8/8R-T	150		
IBS RT 24 DIO 16/8-2A-T	100		
IBS RT 24 DIO 16/16-T	100		
IBS RT 24 DO 16-T	100		
IBS RT 24 DO 32-T	100		
IBS RT 120 DI 16-T	40	9-pos. D-SUB/9-pos. D-SUB	
IBS RT 120/230 DO 16-T	Typ. 40 at 120 V AC Typ. 30 at 230 V AC		
IBS RT 230 DI 16-T	30		

Sensor/Actuator Boxes (SAB)	Current Consumption (mA)*	Connection Type IN/OUT	Cable Type
IBS SAB 24 DI 4/4	100	5-pos. MINI-COMBICON/ 5-pos. MINI-COMBICON	Remote bus/ Installation remote bus
IBS SAB 24 DI 8/8	100		
IBS SAB 24 DI 8/16	100		
IBS SAB 24 DIO 4/4/2	100		
IBS SAB 24 DIO 8/4/4	100		
IBS SAB 24 DO 8/8	100		

Motor Starters	Current Consumption	Connection Type IN/OUT	Cable Type
IBS IP 500 ELR 2-6A DI 8/4	Typ. 0.3 A + sensor current	5-pos. MINI-COMBICON/ 5-pos. MINI-COMBICON	Installation remote bus
IBS IP 500 ELR P-6A DI 4/4	Typ. 0.3 A + sensor current		
IBS IP 500 ELR W-6A DI 4/4	Typ. 0.3 A + sensor current		
IBS IP 500 ELR WP-6A DI 4/4	Typ. 0.3 A + sensor current		
IBS IP 500 ELR WS-12A DI 4/4	Typ. 0.3 A + sensor current		

CT-I/O Gateways	Current Consumption (mA)	Connection Type IN/OUT	Cable Type
IBS CT 24 IO GT-LK	160	F-SMA/F-SMA	Fiber optic
IBS CT 24 IO GT-T	240	10-pos. MINI-COMBICON/ 10-pos. MINI-COMBICON	Remote bus

* Typical current consumption from the installation remote bus (500 mA permissible current consumption at nominal voltage per module (with load))

3.3 Connecting INTERBUS Devices

Local bus devices

Local bus devices are connected to the remote bus with a BK module. Local bus devices can only be combined with each other. They cannot be combined with any other remote bus devices. This applies for ST modules (Smart Terminals).

Remote bus devices

In general, remote bus devices with fiber optic connection cannot be connected with remote bus devices using copper cables. For the conversion from fiber optic to copper (and vice versa) Phoenix Contact offers corresponding interface converters.

Table 3-4 Connecting remote bus devices (copper)

To INTERBUS IN / **From INTERBUS OUT**			ST-BK RT module	ST-BKM	SAB Motor starter		CT-I/O gateway
			D-SUB female connector, 9-pos.	MINI-COMBICON, 8-pos.	MINI-COMBICON, 5-pos.		MINI-COMBICON, 10-pos.
			RB	RB	RB	IRB	RB
ST-BK RT module	D-SUB male connector, 9-pos.	RB	x	x	x	–	x
ST-BKM	MINI-COMBICON, 8-pos.	RB	x	x	x	–	x
SAB Motor starter	MINI-COMBICON, 5-pos.	RB	x	x	x	–	x
		IRB	–	–	–	x	–
CT-I/O gateway	MINI-COMBICON, 10-pos.	RB	x	x	x	–	x

x The following remote bus devices can be connected with each other.

– The following remote bus devices **cannot** be connected with each other.

RB Remote Bus

IRB Installation Remote Bus

BK Bus terminal module

Section 4

This section informs you about

– the module overlapping properties of ST modules

4 ST Modules (Smart Terminals)

4.1 Product Description

ST modules are used for I/O stations with a medium to high I/O number or functional groups.

In most cases the electronics module is pluggable. It can be easily exchanged without having to remove a wire from the terminal block.

The ST modules are connected to INTERBUS through a bus terminal module (BK module). An ST compact station is comprised of a BK module and up to eight I/O modules (see Figure 4-1). The BK module supplies the communications power to the I/O modules. In the bus topology, a compact station is the same as a local bus, as it is connected to the remote bus through a BK module.

Types

Analog and digital input/output modules are available in the ST family. Special function modules are also available.

ST family modules can have: (In addition to the listed versions, there are many modules in a standard version and a version with extended functionality. Almost all modules are available either with screw-clamp or spring-clamp terminals):

- 8, 16, or 32 digital inputs each having 24 V DC supply voltage; 16 digital inputs alternatively with 24 V AC, 120 V AC or 230 V AC supply voltage
- 8, 16, or 32 digital outputs each having 24 V DC supply voltage;
  16 digital outputs with 250 mA or 500 mA output current;
  8 digital outputs with 120 - 230 V AC supply voltage;
  digital output modules with 16 relay N/O contact outputs
- 8 digital inputs and 8 relay contact changeover outputs;
  8 digital inputs and 8 digital outputs;
  8 digital inputs and 8 digital outputs (with special functions)
- 2, 4, or 8 analog inputs (with special functions)
- 4 or 8 analog outputs (with special functions)
- Special function modules like counters, positioning modules, V.24 (RS-232) interfaces, ASI link module
- BK modules with copper fiber-optic connection
- BK module with 8 digital inputs and 8 digital outputs and with copper or fiber-optic connection

– BK module with 8 digital inputs and 8 digital outputs and remote bus branch and with copper or fiber-optic connection
– BK module with remote bus or local bus branch
– BK module with dual bus connection (redundancy)

Positioning

ST modules (IP 20 protection) are used for applications in closed control cabinets. Because of their compact design, ST modules can be located in small control cabinets.

Mounting

ST modules are rail mounted and grounded through the mounting rail.

Bus connection

The remote bus is connected through 9-pos. D-SUB connectors or MINI-COMBICON connectors.

Alternatively, BK modules are available with fiber-optic connection.

ST modules are connected with each other through ST cables (local bus connection).

I/O connection

ST modules have multi-wire terminals to connect 2-, 3- and 4-wire sensors or actuators. For the connection of the wires the screw-clamp or spring-clamp method is used.

When connecting sensors and actuators please note that the terminal numbering of the inputs and outputs does not always correspond to the mapping of the data in the INTERBUS data word.
Each module-specific data sheet shows the assignment of the module terminals to the INTERBUS data word.

4.2 Structure

4.2.1 Structure of an ST Compact Station

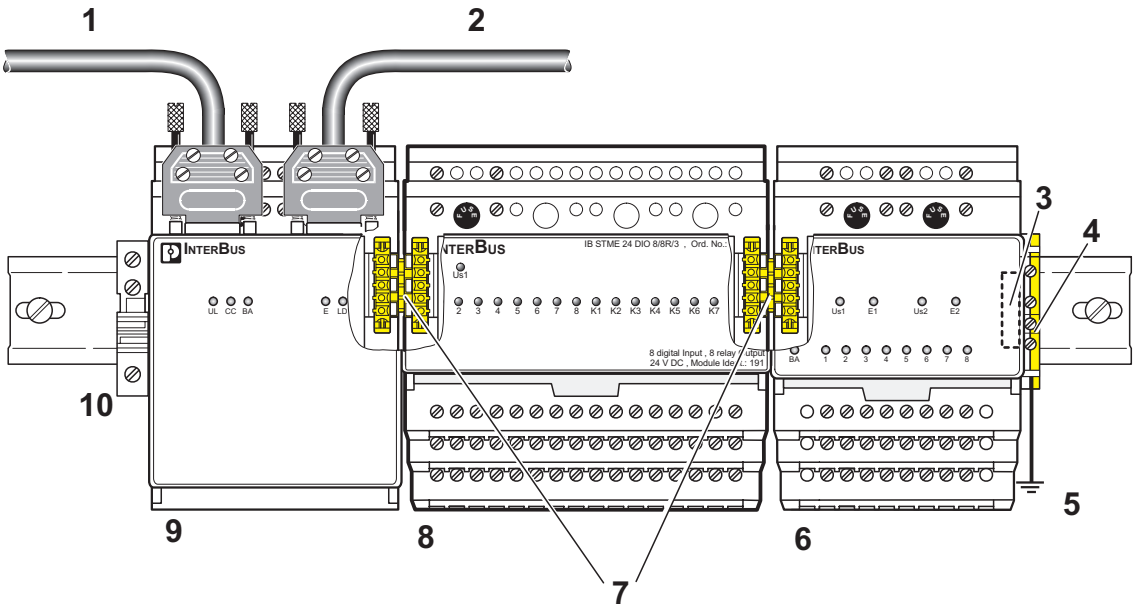


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Figure 4-1 Structure of an ST compact station

1 Incoming remote bus
2 Outgoing remote bus
3 Dummy plug
4 Grounding terminal
5 Protective earth ground
6 Module 2
7 ST cable (supplied with the module)
8 Module 1
9 Bus terminal module (BK)
10 End clamp

Use a dummy plug to isolate the open local bus connection of the last ST module. The dummy plug is delivered with each ST BK module.

4.2.2 Structure of an ST Bus Terminal Module

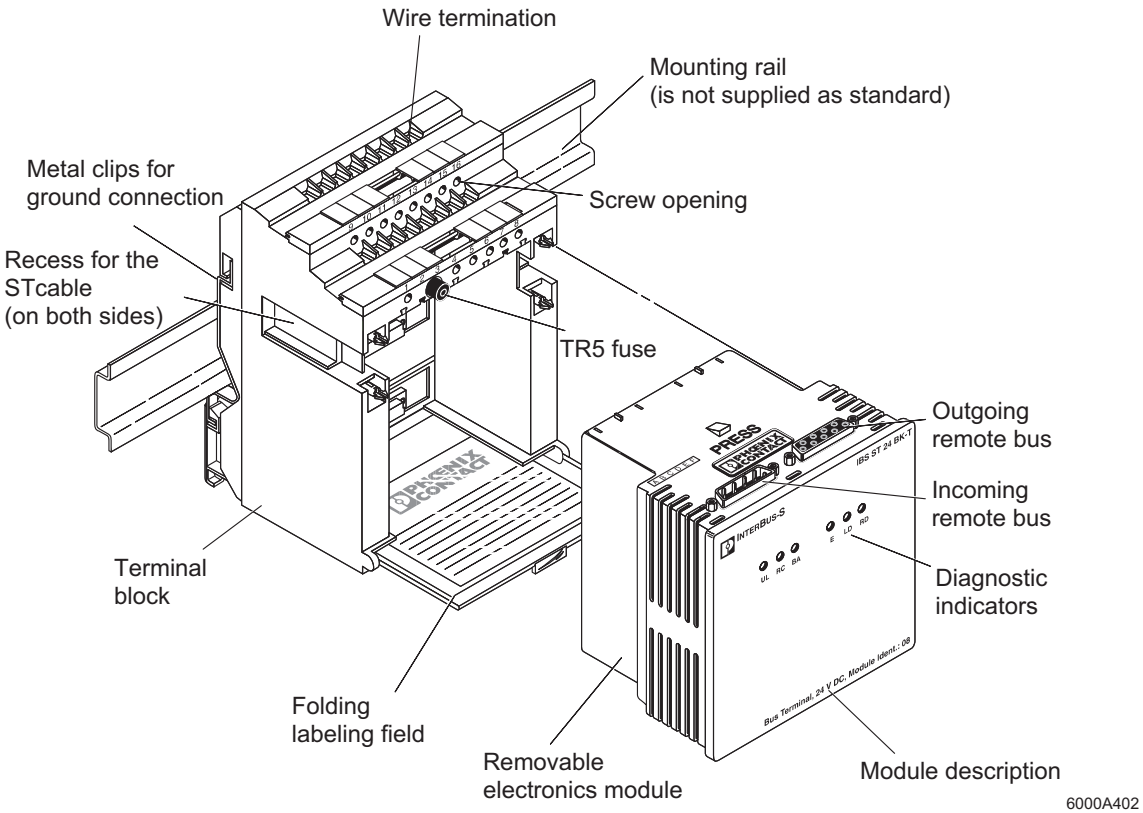


Figure 4-2 Structure of an ST BK module

The ST BK module connects the ST modules with the remote bus. It supplies the bus logic of the connected INTERBUS ST modules with communications power through the ST cable.

The number of ST modules that can be connected on a specific local bus depends on the current consumption of the modules (see „INTERBUS Devices for Dimensioning the Bus Structure“ auf Seite 3-11).

The ST BK module is also available with fiber-optic connection.
BK modules are available with additional interfaces and/or I/O connections.

Certain BK modules allow the creation of a remote bus branch (IBS ST 24 BK-RB-T) or a local bus branch (IBS ST 24 BK-LB-T).

4.2.3 Structure of an ST Module

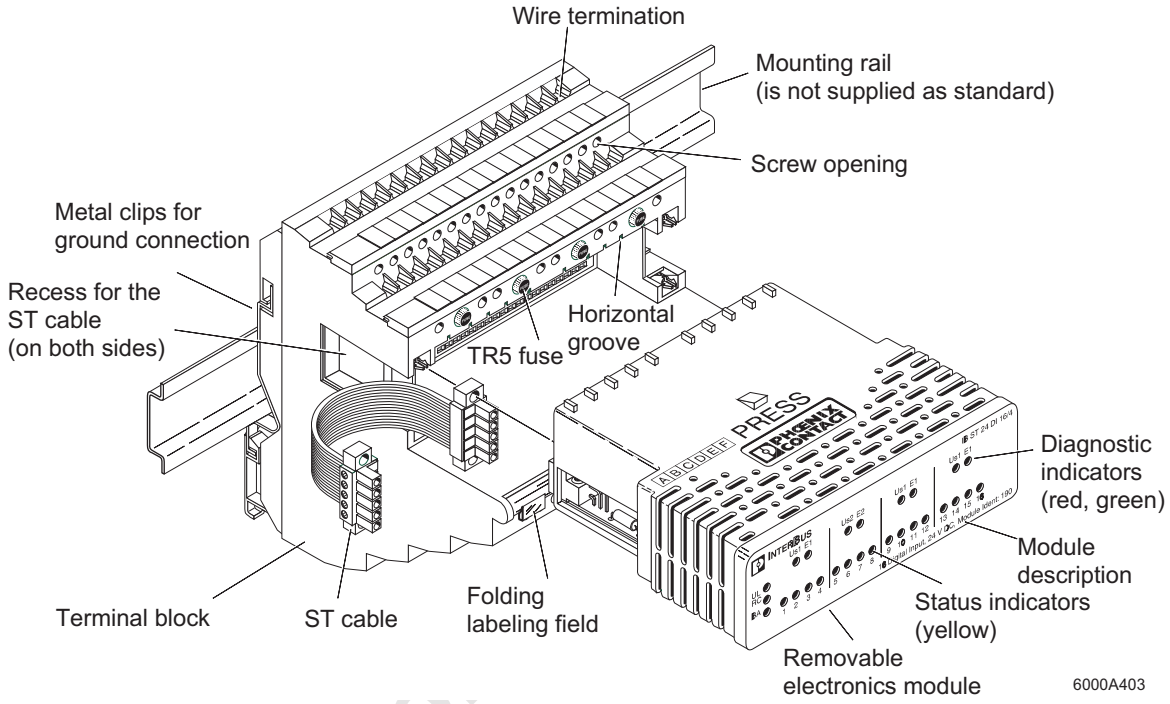


Figure 4-3 Structure of an ST module (screw-clamp variant)

The design of the ST modules for analog and digital signals is similar. You can directly wire the sensors and actuators to ST modules with the multi-wire connection method. The wire termination is possible through screw-clamp or spring-clamp terminals ("ZF" extension in the order designation).

Labeling Field

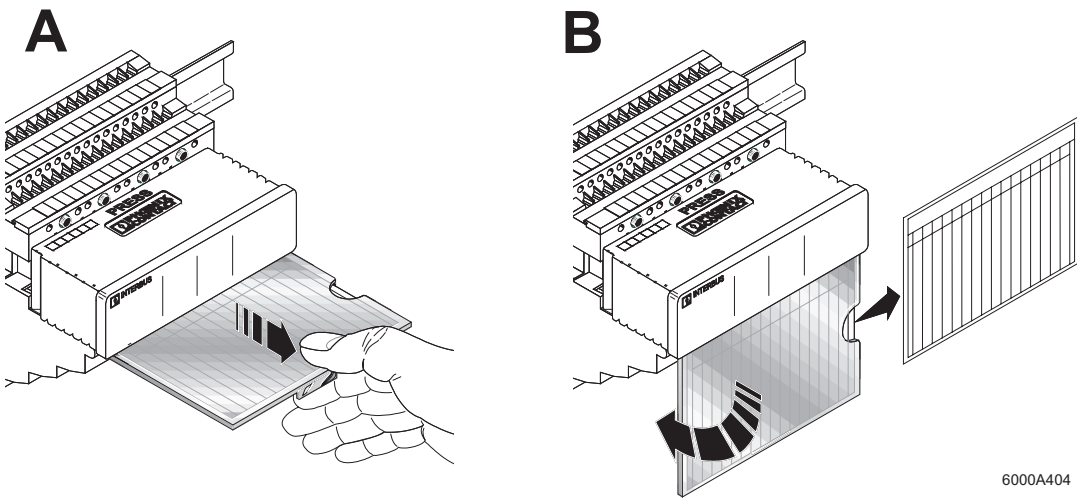


Figure 4-4 Labeling field

The labeling field integrated in the module housing offers enough space to assign the signal name to the terminal points.

Pull the labeling field out of the housing (Figure 4-4; A), label the corresponding field and re-insert the labeling field (Figure 4-4; B).

4.3 Diagnostic and Status Indicators

For quick local error diagnostics, the modules have diagnostic and status indicators.

Diagnostics

The diagnostic indicators (red/green) indicate the type and location of the error. The module is functioning correctly if all of the green LEDs are on.

Status

The status indicators (yellow) indicate the status of the corresponding input or output.

The LEDs listed below are typical for INTERBUS modules, but not all of the LEDs are on every module. Depending on the module type, additional indicators can also indicate the status of the module.

For additional information about a certain module please refer to the corresponding data sheet.

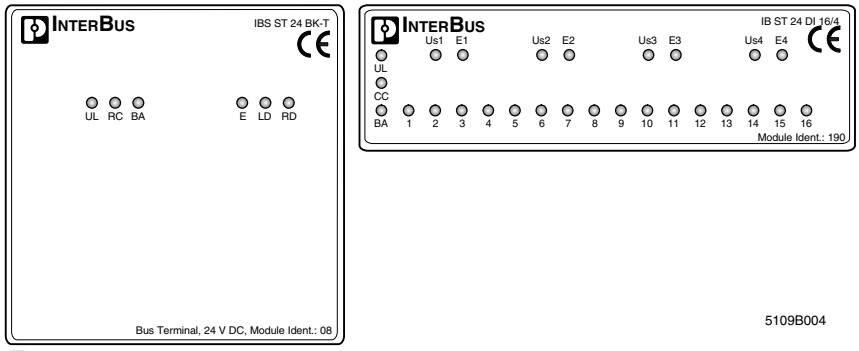


Figure 4-5 Typical diagnostic and status indicators

4.3.1 LEDs on BK Modules

Depending on the type of BK module, the following states can be read:

Diagnostics

UL	Green LED	Supply voltage of the electronics module
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present – Fuse blown – Internal power supply unit defective
RC	Green LED	Remote bus connection (remote bus check)
	ON:	Incoming remote bus connection established
	OFF:	Incoming remote bus connection defective
BA	Green LED	Bus active (remote bus active)
	ON:	Data transmission on INTERBUS active
	OFF: As of G4	No data transmission
	Flashing:	Bus active, but no cyclic data transmission
E	Red LED	Local bus error
	ON:	Error
	OFF:	No error
LD	Red LED	Local bus disabled
	ON:	Local bus switched off
	OFF:	Local bus switched on
RD	Red LED	Remote bus disabled
	ON:	Outgoing remote bus switched off
	OFF:	Outgoing remote bus switched on

Status

If BK modules have an input/output function, the status of the corresponding input/output can be read.

XX	Yellow LED	Status input/output
	ON:	Corresponding input/output is set
	OFF:	Corresponding input/output is not set

4.3.2 LEDs on Input/Output Modules

Diagnostics

US	Green LED	I/O supply voltage
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present
UL	Green LED	Supply voltage of the electronics module
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present – Incoming ST cable not plugged in – Fuse blown in BK module – Internal power supply unit of the BK module defective
CC	Green LED	Incoming ST cable connection
	ON:	ST cable connection established
	OFF:	ST cable connection defective
BA	Green LED	Bus active (remote bus active)
	ON:	Remote bus active
	OFF: As of G4	Remote bus not active
	Flashing:	Bus active, but no cyclic data transmission
E(n)	Red LED	Error of a certain group
	ON:	– Short circuit or overload of an output of the group (n) – Short circuit or overload of the sensor supply of a group (n)
	OFF:	– No error

Status

The status of the input/output can be read on the corresponding yellow LED:

XX	Yellow LED	Status input/output
	ON:	Corresponding input/output is set
	OFF:	Corresponding input/output is not set

LEDs on PCP modules

In addition, there is a TR LED on PCP-compatible modules.

TR	Green LED	Transmit Receive (parameter channel active)
	ON:	PCP active (module receives/sends data)
	OFF:	PCP not active

4.4 Mounting ST Modules

In general, ST modules are mounted onto mounting rails.

4.4.1 Mounting Distances

The space required for the routing of a bus depends on the number of cables to be installed and the amount of free space required to the left and/or to the right of the compact station.

To minimize interference, we recommend, wherever possible, that you do not run signal cable in parallel with power cable. In places where these cables must be run in parallel, we recommend maintaining the maximum separation possible. In the example below, the left cable duct could be used for the signal lines and bus cables and the right cable duct for power supply lines. This way, minimum parallel cabling can be ensured and interference on the signal lines be limited.

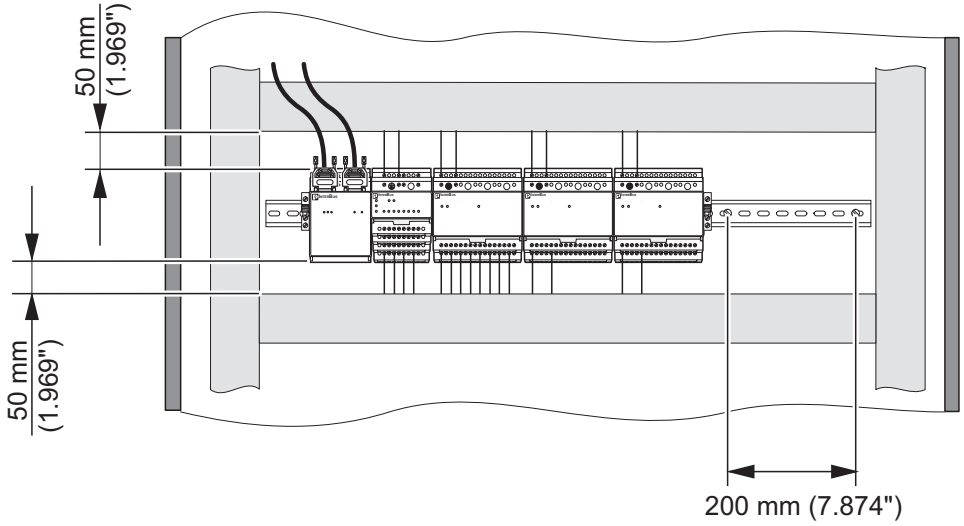


Figure 4-6 Distances for rail mounting

The upper and lower cable ducts maintain a minimum distance of 50 mm (1.969 in.) from the ST modules. If the distance is smaller, the minimum bending radius of the cables, easy handling at installation and a clear structure cannot be guaranteed.

The distance between mounting rail fasteners must not exceed 200 mm (7.874 in.). This distance is necessary for the stability of the rail when mounting and removing ST modules.

4.4.2 ST Module Dimensions

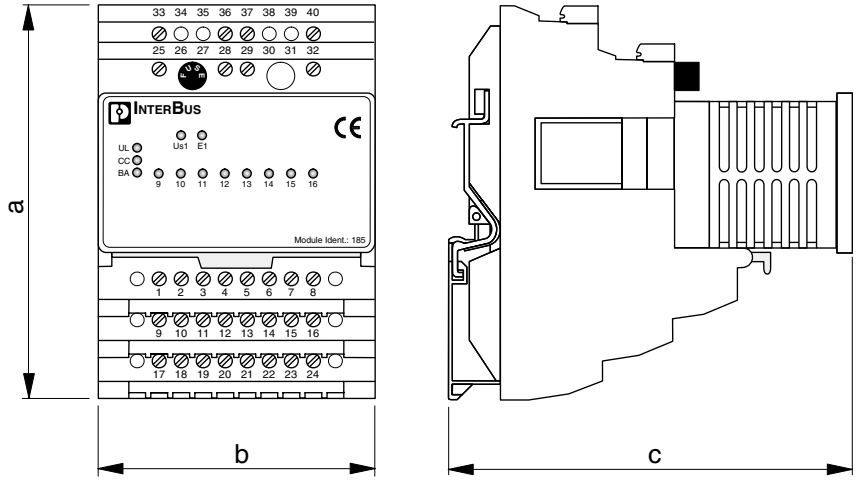


Figure 4-7 Dimension variables for ST modules

There are three standard housing sizes for ST modules.

Table 4-1 Housing sizes of ST modules

	Height a	Width b	Depth c
Housing size 1	116 mm (4.567 in.)	118 mm (4.646 in.)	117 mm (4.606 in.)
Housing size 2	116 mm (4.567 in.)	81 mm (3.189 in.)	117 mm (4.606 in.)
Housing size 3	116 mm (4.567 in.)	44 mm (1.732 in.)	117 mm (4.606 in.)

For the size of a particular module please refer to the corresponding data sheet or the INTERBUS catalog.

4.4.3 Mounting ST Modules

Rail mounting

Install a clean and corrosion-free mounting rail (DIN EN 50022, Phoenix Contact: Order Designation NS 35…) on the mounting surface.

For sufficient stability, the mounting rail must be fastened at least every 200 mm (7.874 in.).

Grounding

Connect the mounting rail with protective earth ground using grounding terminals. The modules are grounded when they are installed on the mounting rail.

Further grounding with a ground bus should be performed in accordance with all applicable local regulations and standards. The necessary components are listed in the Phoenix Contact catalog.

Structure of an ST compact station

The first module of an ST compact station is always an ST BK module. Fasten an end clamp on the left side of the BK module on the mounting rail. This clamp is to prevent the module from sliding sideways.

Preferred installation position

Mount the modules on a horizontally positioned mounting rail.

Removing the electronics module

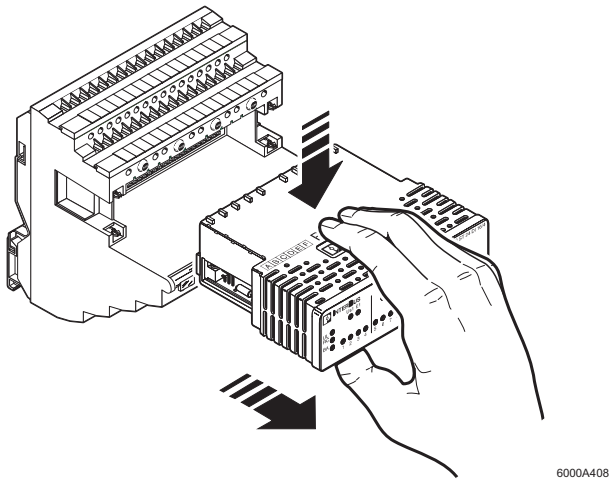


Figure 4-8 Replacing the electronics module

- Press lightly on the area marked "PRESS" on the top side of the electronics module housing and pull the module out.

Mounting a terminal block base

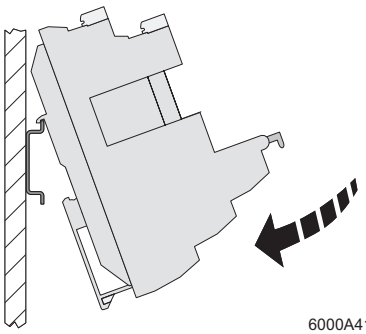


Figure 4-9 Mounting the terminal block base

- Snap the terminal block base onto the mounting rail. Ensure that both upper clips are on rail.
- Push the module towards the mounting surface.

Mounting the ST cable

The ST cables are supplied as standard with the modules.
The ST cables must not be modified or extended!

Before mounting the ST cables remove the electronics module.

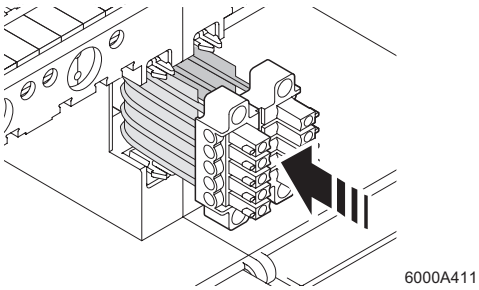


Figure 4-10 Mounting the ST cables

- Place the connector of the ST cable on the locking clips of the modules to be connected.
- The local bus connection on the last ST module must be isolated with a dummy plug. The dummy plug is delivered with each ST BK module.

Mounting the electronics module

- Push the electronics module carefully, as far as possible into the terminal block base. Make sure that the connectors of the ST cable have the correct encoding.

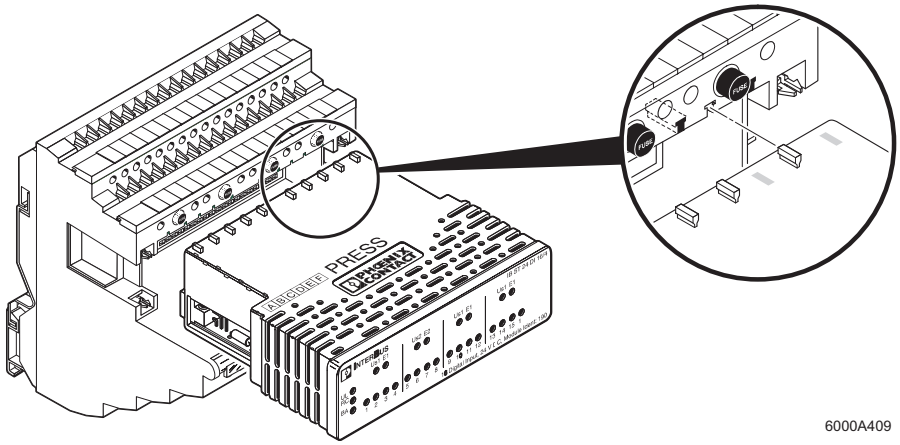


Figure 4-11 Mechanical keying of the electronics module

- Make sure that the electronics module is securely placed.

4.4.4 Removing ST Modules

Removing the electronics module

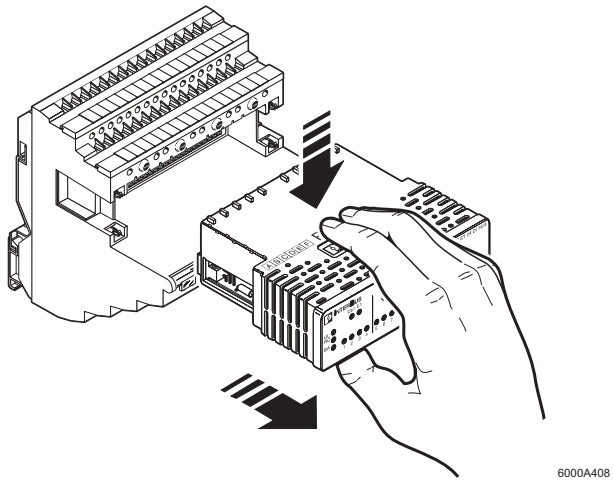


Figure 4-12 Replacing the electronics module

- Press lightly on the area marked "PRESS" on the top side of the electronics module housing and pull the module out.

Removing the ST cables

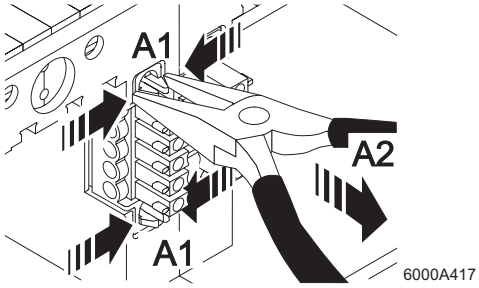


Figure 4-13 Removing the ST cables

- Use an appropriate tool to push the locking clips carefully together until the locking clips release the MINI-COMBICON connector (Figure 4-13; A1).
- Remove the connector (Figure 4-13; A2).

Removing the module from the mounting rail

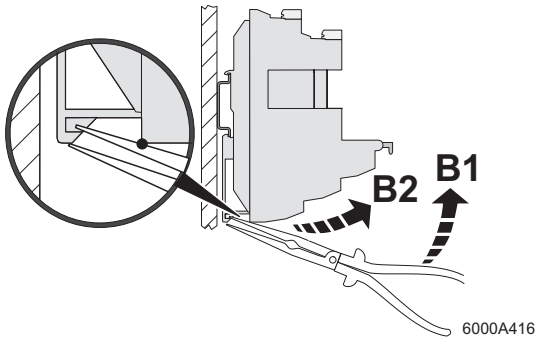


Figure 4-14 Removing the terminal block base

- To remove the module, insert an appropriate tool into the latch.
- Pull the tool upwards (Figure 4-14; B1).
- Remove the module from the rail in a vertical direction (Figure 4-14; B2).

4.5 Connecting the Remote Bus

4.5.1 Connecting a Remote Bus With a D-SUB Connector

INTERBUS uses a 6-wire cable that is available by the meter (IBS RBC METER-T, Order No. 28 06 28 6)

For more detailed information, please refer to „Assembling D-SUB Connectors“ auf Seite 2-20.

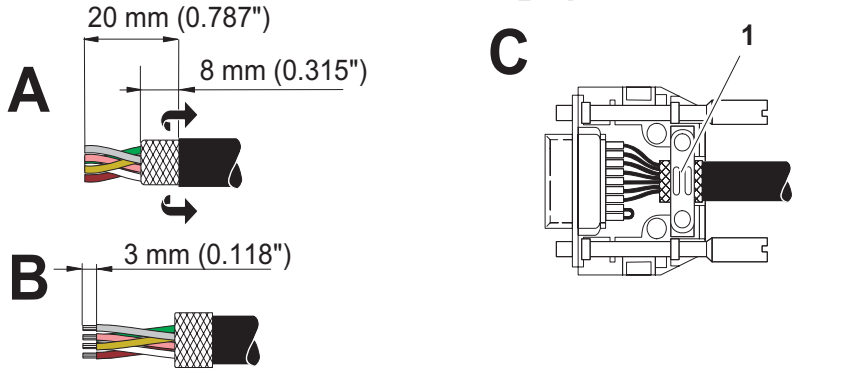


Figure 4-15 Connecting the remote bus cable

- Strip 20 mm (0.787 in.) off the cable sheath.
- Shorten the braided shield to 8 mm (0.315 in.).
- Fold the shielding uniformly back over the sheath.
- Strip 3 mm (0.118 in.) off the wires. Cut off the white wire as it is not required.
- Connect the wires to the contacts.
- Clamp the shield under the strain relief (1) to create a conductive connection with the housing (Figure 4-15; C).

Pin assignment

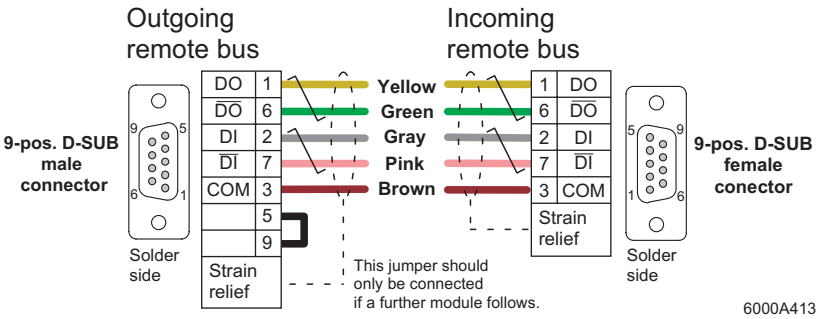


Figure 4-16 D-SUB connector pin assignment

Contacts 5 and 9 must be jumpered in the outgoing remote bus male connector.

4.5.2 Connecting a Remote Bus With MINI-COMBICON

The following connection procedure only applies for the bus terminal module IBS ST (ZF) 24 BKM-T.

Fit the 8-pos. MINI-COMBICON male connectors that are also supplied to the remote bus cable.

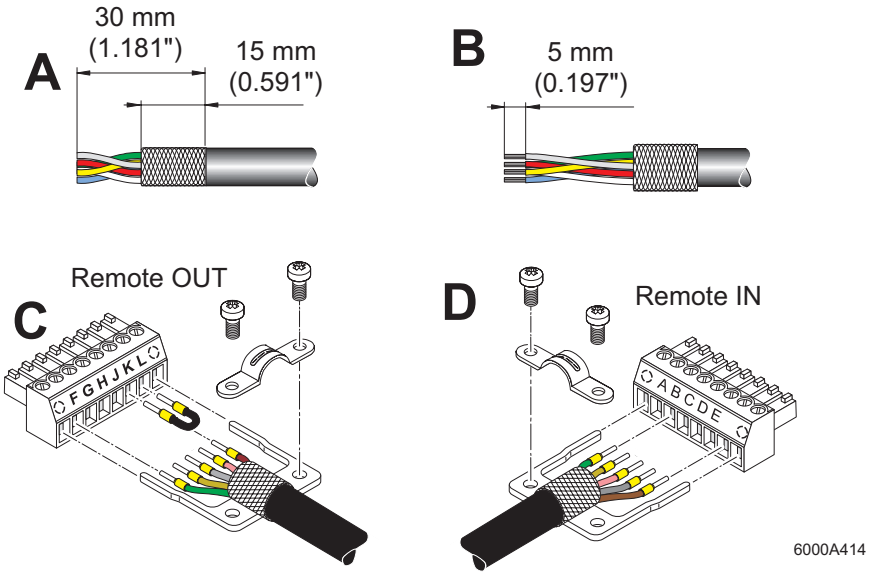


Figure 4-17 Assembling MINI-COMBICON male connectors

- Strip approx. 30 mm (1.181 in.) off the outer cable sheath (Figure 4-17; A).
- Shorten the braided shield to 15 mm (0.591 in.) (Figure 4-17; A) and place it around the outer cable sheath (Figure 4-17; B).
- Remove the protective foil.
- Cut off the white wire close to the outer cable sheath, as it is not required.
- Strip approx. 5 mm (0.197 in.) off the wires (Figure 4-17; B).
- Crimp ferrules to the end of the wires.
- Wire the corresponding connectors according to the following figure.

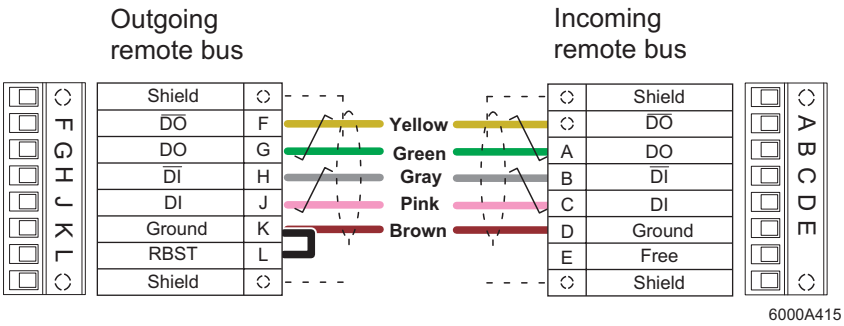


Figure 4-18 Pin assignment of the MINI-COMBICON connectors

A jumper must be installed between the contacts K and L of the outgoing remote bus connector (Remote OUT). The jumper indicates that another module follows.

- Connect the shield clamp to the corresponding contacts of the connector. The clamp ensures proper strain relief (Figure 4-17; C or D).
- Fasten the shield clamp so that as much of the braided shield as possible is held underneath the clamp.

Plugging the MINI-COMBICON Connectors

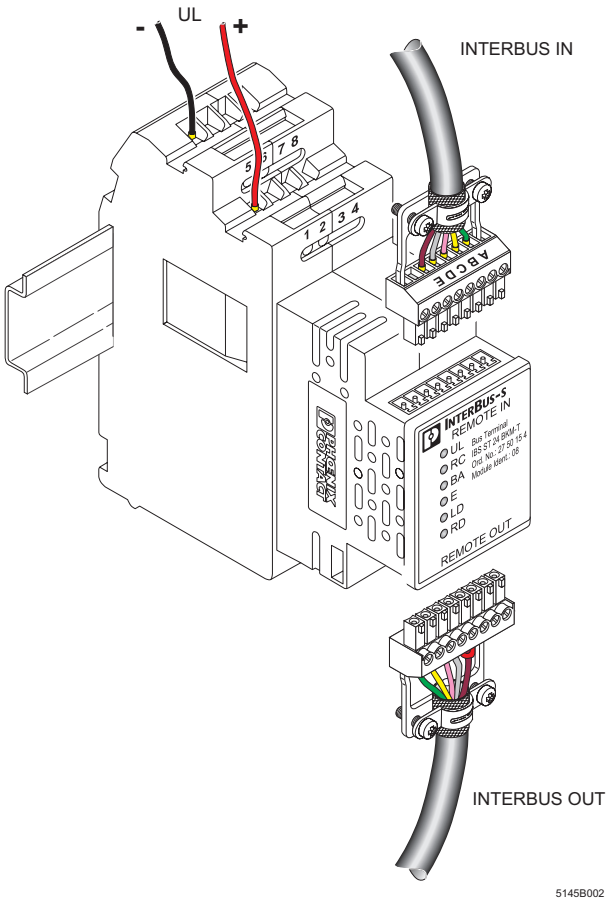


Figure 4-19 IBS ST (ZF) 24 BKM-T

- Plug the connectors into the corresponding terminal strips, so that the keying tabs match.

Remote IN designates the incoming remote bus.
Remote OUT designates the outgoing remote bus.

4.5.3 Connecting a Remote Bus Using Fiber Optics

If modules are followed by another remote bus device you must set the NEXT-END switch to NEXT.
You must set the NEXT-END switch of the last remote bus module to END.

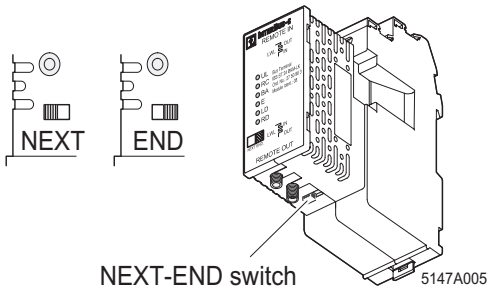


Figure 4-20 Example of the position of the NEXT-END switch

Refer to the package slips of the F-SMA connectors and the "Optical Fiber Installation Guidelines" (DB GB IBS SYS FOC ASSEMBLY, Part No. 94 23 43 9) when assembling fiber optics.

- Fit the F-SMA connectors to the fiber-optic cables.
- Plug the connectors onto the sockets provided and secure the connection with the cap nuts.

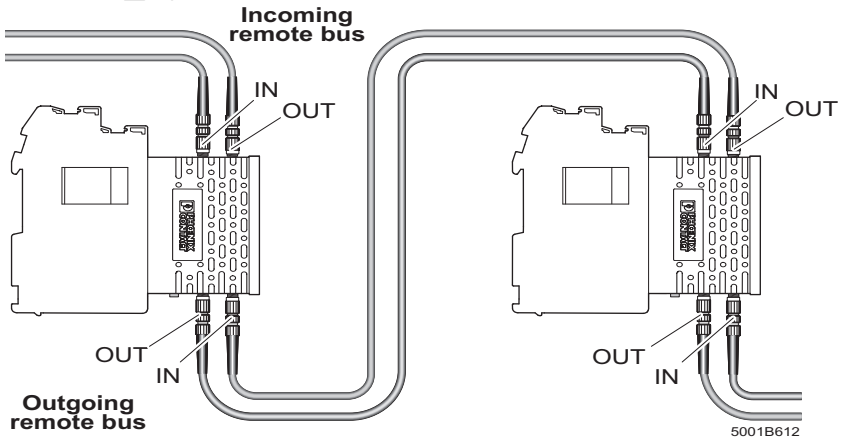


Figure 4-21 Fiber-optic connections

- Connect the supply voltage U_L for the module electronics. For details please refer to the data sheets.

4.6 Common Technical Data

This data is valid for the preferred mounting position (vertical).

The technical data does not claim to be complete. Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Ambient Conditions	
Regulations	Developed according to VDE 0160, UL 508
Ambient temperature	Module-specific
Humidity	Operation: 30% to 75% (no condensation) Storage/transport: 30% to 95% (no condensation)
Air pressure	Operation: 86 kPa to 108 kPa (up to 1500 m [4921 ft.] above sea level) Storage: 66 kPa to 108 kPa (up to 3500 m [11483 ft.] above sea level)
Ventilation	Hanging module, natural convection
Degree of protection	IP 20, according to DIN 40050, IEC 60529
Class of protection	Class 3 according to VDE 0106, IEC 60536
Air and creepance distances	According to IEC 60644/ IEC 60664A/ DIN VDE 0110: 1989-01 and DIN VDE 0160: 1988-05
Housing material	PA6.6 V0, self-extinguishing (V0)
Environmental compatibility	Module-specific
Vibration test	Module-specific
Shock test	Module-specific

Supply of the Electronics Module Through the BK Module	
Supply voltage of the local bus	9 V DC
Current consumption	Module-specific

I/O Supply Voltage (U_S)	
Nominal value	U_S = 24 V DC (special variants are possible)
Ripple	U_{PP} = 3.6 V within the permissible voltage range
Permissible voltage range	18.5 V DC to 30.5 V DC, ripple included (special variants are possible)

Connection Type	
Remote bus	Copper: 9-pos. D-SUB connector (IBS ST (ZF) 24 BKM-T: 8-pos. MINI-COMBICON) Fiber optic: F-SMA connector
I/O connection	COMBICON screw-clamp terminals (2.5 mm² [14 AWG] wire) or COMBICON spring-clamp terminals (1.5 mm² [16 AWG] wire)

Data Interface to INTERBUS	
INTERBUS interface	ST cable
Cable lengths	Max. 400 m between ST bus terminal modules and other remote bus devices; ST local bus modules must be directly mounted side by side
Error evaluation	Diagnostic and status indicators
Electrical isolation	Module-specific

Ordering Data (Accessories)

Description	Order Designation	Order No.
Fuses		
3.15 A fast-blow	IBS TR5 3,15AF	27 19 25 0
4 A fast-blow	IBS TR5 4 AF	27 53 46 5
0.2 A slow-blow	IBS TR5 0,2T	27 53 45 2
0.4 A slow-blow	IBS TR5 0,4AT	27 53 47 8
1 A slow-blow	IBS TR5 1AT	28 06 60 0
1.6 A slow-blow	IBS TR5 1,6AT	27 67 36 7
2 A slow-blow	IBS TR5 2AT	27 52 50 5
5 A slow-blow	IBS TR5 5AT	27 67 38 3
6.3 A very quick acting	SI 5x20 6,3 AFF DIN 41662	27 26 10 4
Zack "Quick" marker strips to label the terminals	ZB 6 ... see Phoenix Contact catalog	
DIN EN 50022 mounting rail, 2 meters	NS 35/7,5 perforated NS 35/7,5, unperforated	08 01 73 3 08 01 68 1
Screwdriver according to DIN 5264, blade width 3.5 mm (0.138 in.) (9/64)	SZF 1 - 0,6 x 3,5	12 04 51 7

For varying module data, please refer to the corresponding data sheet or the INTERBUS catalog.

Section 5

This section informs you about

– the module overlapping properties of RT modules

5 RT Modules (Remote Terminals)

5.1 Product Description

RT modules are compact I/O units with integrated remote bus module functions. RT modules can be directly installed in the INTERBUS remote bus. We recommend the use of RT modules when only a few input/output points are required.

RT modules can be combined with all INTERBUS-compatible devices.

Types

In the RT product family, modules with digital and analog input/output functions are available. RT modules can have:

- 16 or 32 digital inputs
- 16 or 32 digital outputs
- 16 digital inputs for 120 V AC or 230 V AC
- 16 digital outputs for 24 V AC or 230 V AC
- 16 digital inputs and outputs (2 A)
- 16 digital inputs and 8 digital outputs
- 8 digital inputs and 8 relay outputs
- 8 analog inputs
- 4 analog outputs
- 4 analog inputs and 2 analog outputs
- Bus terminal module (BK module) with remote bus branch

Positioning

RT modules (IP 20 protection) are used for applications in closed control cabinets. Because of their compact design, RT modules can be located in small control cabinets and machine housings. The flat design allows, e.g., installation in control cabinet doors.

Mounting

RT modules are mounted on standard mounting rails or are installed on a mounting surface.

Bus connection

INTERBUS is connected through 9-pos. D-SUB connectors. The power supply of the electronics module is directly connected through COMBICON connectors (screw-clamp or spring-clamp connection).
The signals of the incoming remote bus are electrically isolated from the rest of the logic through optocouplers.

In addition to the standard connection with copper wires, fiber optics can also be used. For this, you will require the converter IBS OPTOSUB... or OPTOSUB PLUS, depending on the module.

I/O connection

RT modules have multi-wire terminals to connect 1-, 2-, 3- and 4-wire sensors or actuators. The wires are connected with screw-clamp or spring-clamp terminals.

5.2 Structure

5.2.1 Structure of an RT Station

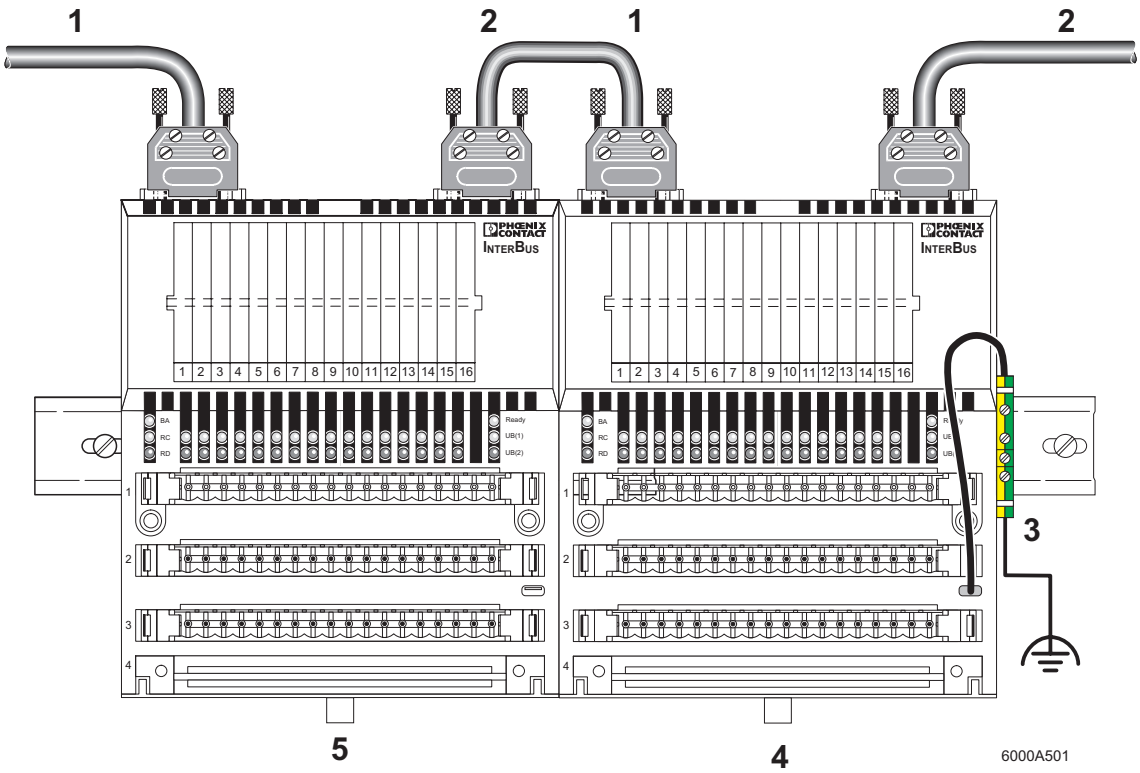


Figure 5-1 Example structure of an RT station

1 Incoming remote bus
2 Outgoing remote bus
3 Protective earth ground
4 Module 2
5 Module 1

5.2.2 Structure of an RT Module

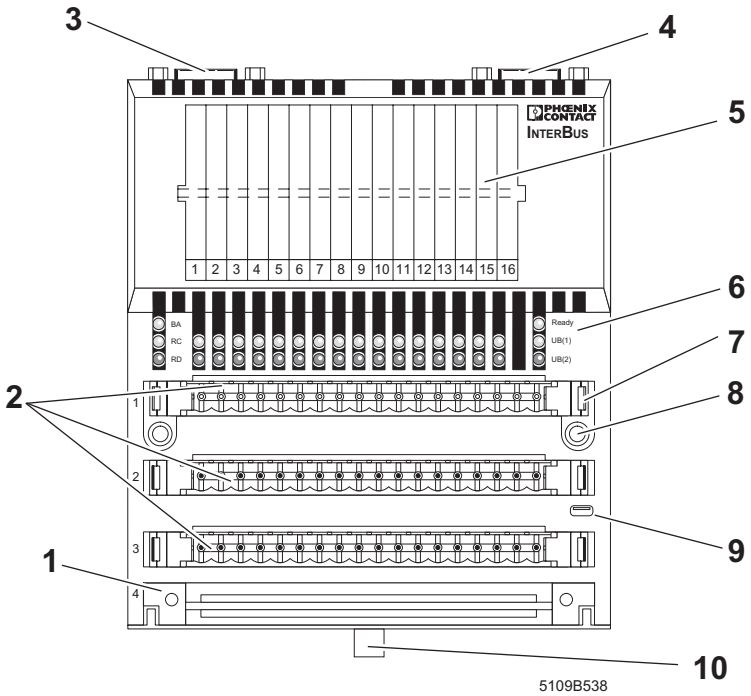


Figure 5-2 Structure of an RT module

1 Slot for bus bar
2 Slot for COMBICON connector
3 Incoming remote bus
4 Outgoing remote bus
5 Labeling field
6 Diagnostic and status indicators
7 Terminal ejector
8 Holes for panel mounting
9 Ground connection
10 Metal strap for snapping onto the mounting rail

The sensors, actuators and supply voltages are connected with three 18-pos. COMBICON connectors that are plugged into the module from the front. In addition, bus bars can be installed on the module for easy multi-wire connections.

COMBICON connectors and bus bars are available as screw-clamp and spring-clamp terminals.

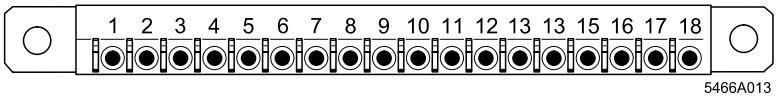


Figure 5-3 Bus bar, single-row

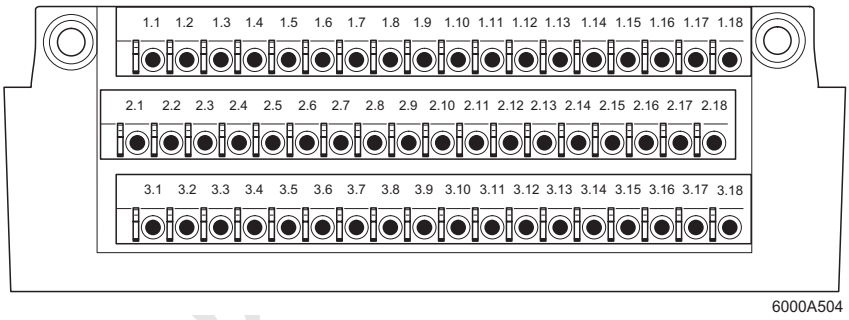


Figure 5-4 Bus bar, triple-row

There are different types of bus bars (each with up to 1.5 mm² (16 AWG) for screw-clamp and spring-clamp terminals):

– Single-row bus bar
– Double-row bus bar
– Triple-row bus bar

COMBICON connector:

– Screw-clamp terminals for wire diameters up to 2.5 mm² (14 AWG)
– Spring-clamp terminals for wire diameters up to 1.5 mm² (16 AWG)

If the bus bar is used as a protective conductor it must be marked with green/yellow tape or the PE symbol.

In the event of an error, the device can be exchanged quickly as the wired terminal strips are pluggable. The corresponding labeling field can be taken off and put on the new device.

5.3 Mounting COMBICON Connectors

The user must key the COMBICON connectors as they are not keyed by the manufacturer.

Depending on the type, the RT modules can be used for dangerous or harmless voltages. Dangerous voltages are voltages over 42.4 V AC and over 60 V DC. The RT modules are delivered with keyed male connectors corresponding to the declared voltage range.

If you operate a module in the harmless voltage range even though it is intended and keyed for dangerous operation, you have to change the encoding of the male connector of the module.

Safety coding

Key each COMBICON connector for the corresponding voltage range. Each COMBICON connector gets four coding tabs that are delivered with the RT modules.

Harmless voltage range: Pins 1, 2 and 17, 18.

Dangerous voltage range: Pins 2, 3 and 16, 17.

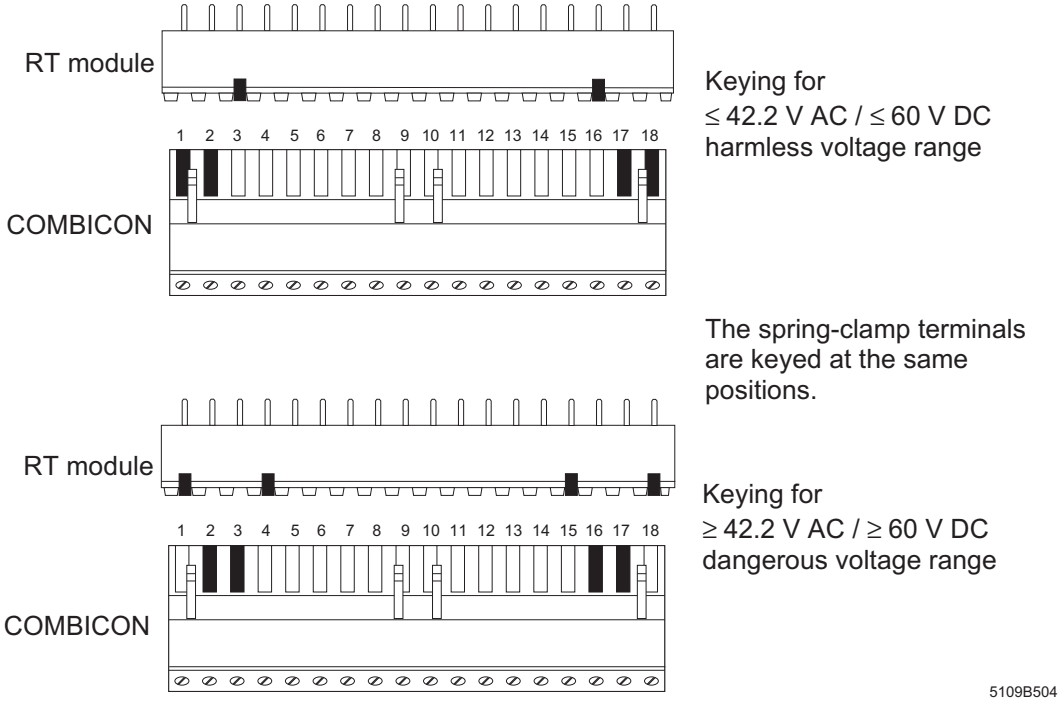


Figure 5-5 Safety coding

Individual keying

The free remaining keying positions can receive any keying to interlock modules of the same type. This however must not interfere with the safety coding or change it.

Connecting and Ejecting COMBICON Connectors

Connect the COMBICON connector pushing it into the pre-keyed terminal strips (rows 1 to 3).

Use a screwdriver to press on the ejectors on both sides of the COMBICON connector and remove the connector.

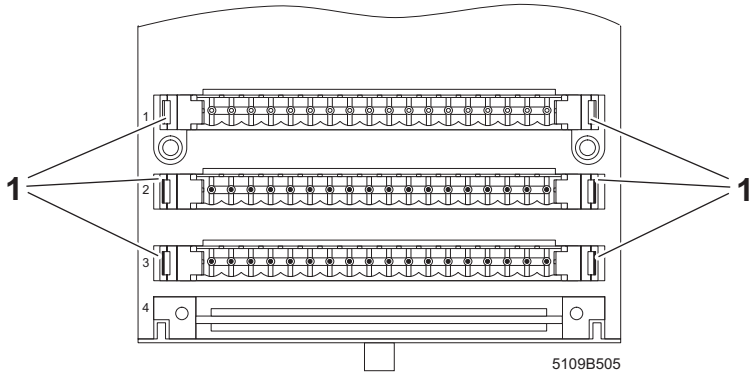


Figure 5-6 Terminal ejectors of the COMBICON connector

1 Terminal ejector

5.4 Diagnostic and Status Indicators

The diagnostic and status indicators of the RT module allow for quick local error diagnostics.

The LEDs listed below are typical for RT modules, but not all of the LEDs are on every module. Depending on the module type, additional LEDs can indicate the operating state of the module.

For additional information on the diagnostic and status indicators please refer to the data sheet of the corresponding RT module.

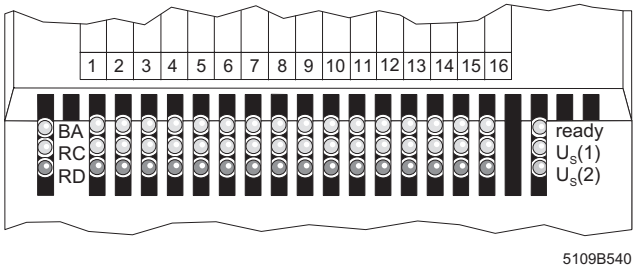


Figure 5-7 Typical diagnostic and status indicators

Diagnostics

The diagnostic indicators (red/green) indicate the status of the modules. The RT module is functioning correctly if all of the green LEDs are on.

Ready	Green LED	Supply voltage of the module electronics
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present – Fuse blown – Internal power supply unit defective – Incoming INTERBUS cable not plugged in
US(n)	Green LED	I/O supply voltage of a group (n)
	ON:	Voltage in permissible tolerance zone
	OFF:	Voltage not present (fuse may be blown)
BA	Green LED	Bus active (remote bus active)
	ON:	Data transmission on INTERBUS active
	OFF:	No data transmission
	As of G4	
	Flashing:	Bus active, but no cyclic data transmission yet

RC	Green LED	Remote bus connection (remote bus check)
	ON:	Incoming remote bus connection established
	OFF:	Incoming remote bus connection defective
RD	Red LED	Remote bus disabled
	ON:	Outgoing remote bus switched off
	OFF:	Outgoing remote bus switched on

Status

The status indicators (green/red) indicate the signal state of the corresponding inputs/outputs. If the green status LEDs are on, this indicates the signal state "1" of the input/output signal or of a group.

XX	Green LED	Status of the input/output
	ON:	Corresponding input/output is set
	OFF:	Corresponding input/output is not set
XX	Red LED	Output error message
	ON:	Overload or short circuit at the output
	OFF:	No error message

5.5 Mounting RT Modules

RT modules can be mounted on mounting rails or panel mounted.

5.5.1 Mounting Distances

The RT modules can be mounted (e.g., on the mounting rail) with their long sides next to each other.

Make sure you observe the minimum distances between two modules mounted on top of each other (see Figure 5-8). The vertical distances are necessary to guarantee sufficient ventilation.

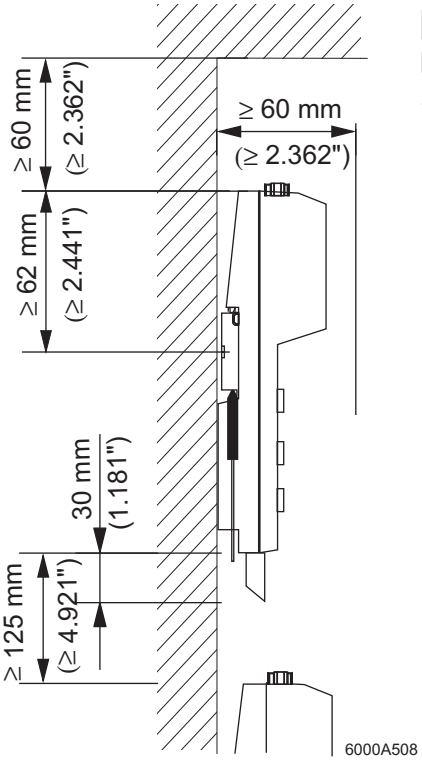


Figure 5-8 Distances when mounting RT modules

5.5.2 RT Module Dimensions

The I/O modules of the RT product family have a uniform housing design. The IBS RT 24 BK RB-T bus terminal module is located in a narrower housing.

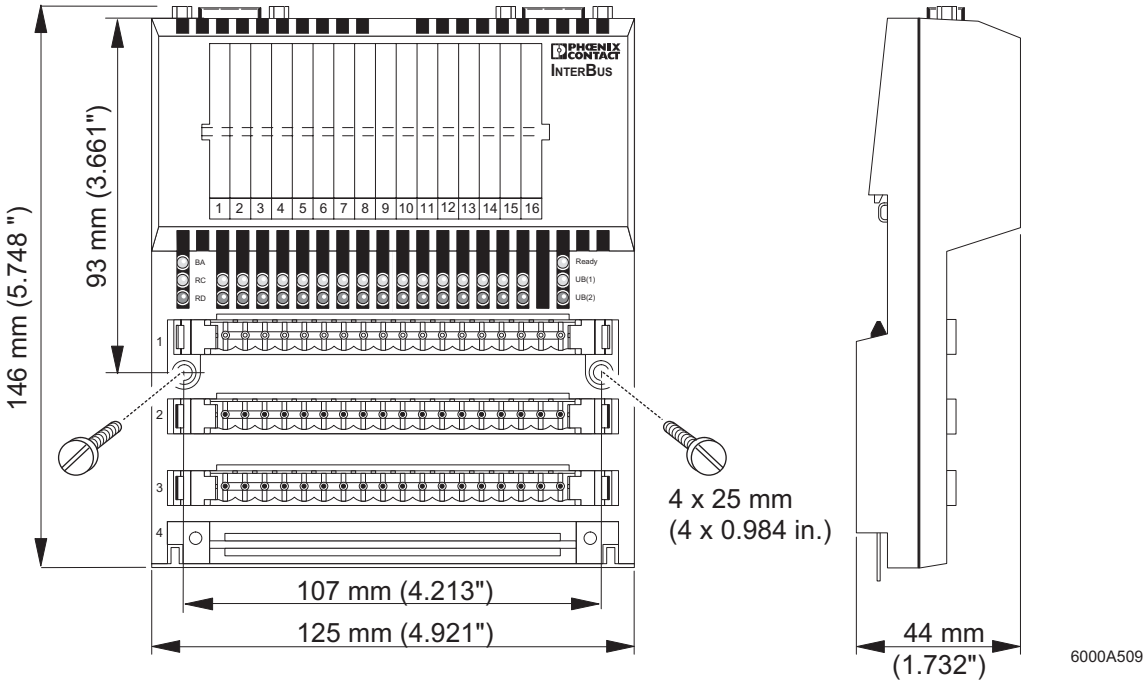


Figure 5-9 Dimensions of the RT I/O modules

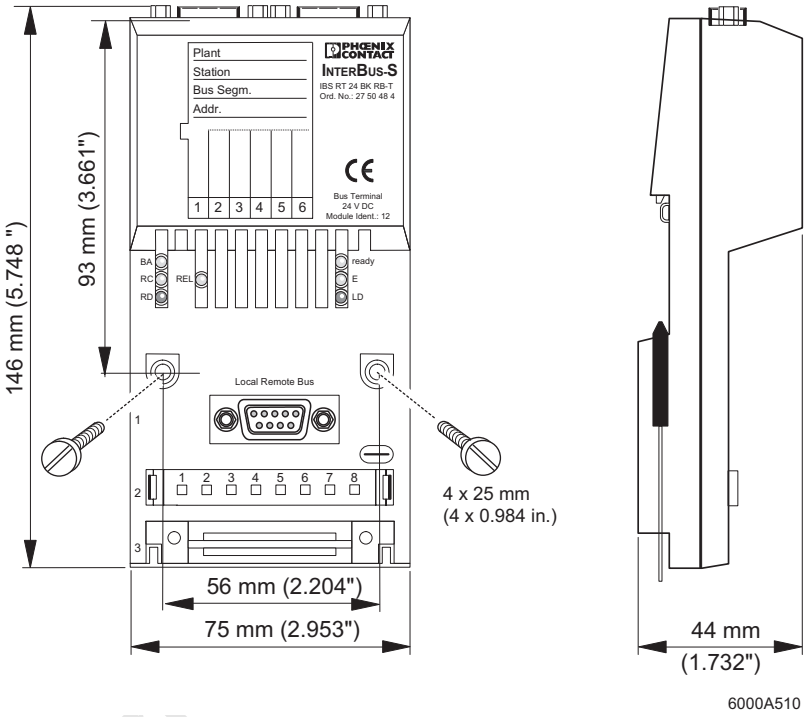


Figure 5-10 Dimensions of the IBS RT 24 BK RB-T module

5.5.3 Mounting RT Modules

RT modules with IP 20 protection can be

– Installed directly onto a mounting rail or
– Mounted directly onto a mounting surface.

Above the terminal strip are vertical ventilation slots supplying sufficient natural convection for cooling, when the modules are mounted vertically.

Make sure you observe the minimum distances between two modules mounted on top of each other. See "Mounting Distances" on page 5-12.

Preferred mounting position

Mount the modules on a horizontally positioned mounting rail.

Rail Mounting

Install a clean and corrosion-free mounting rail (DIN EN 50022, Phoenix Contact: Order Designation NS 35) on the mounting surface.

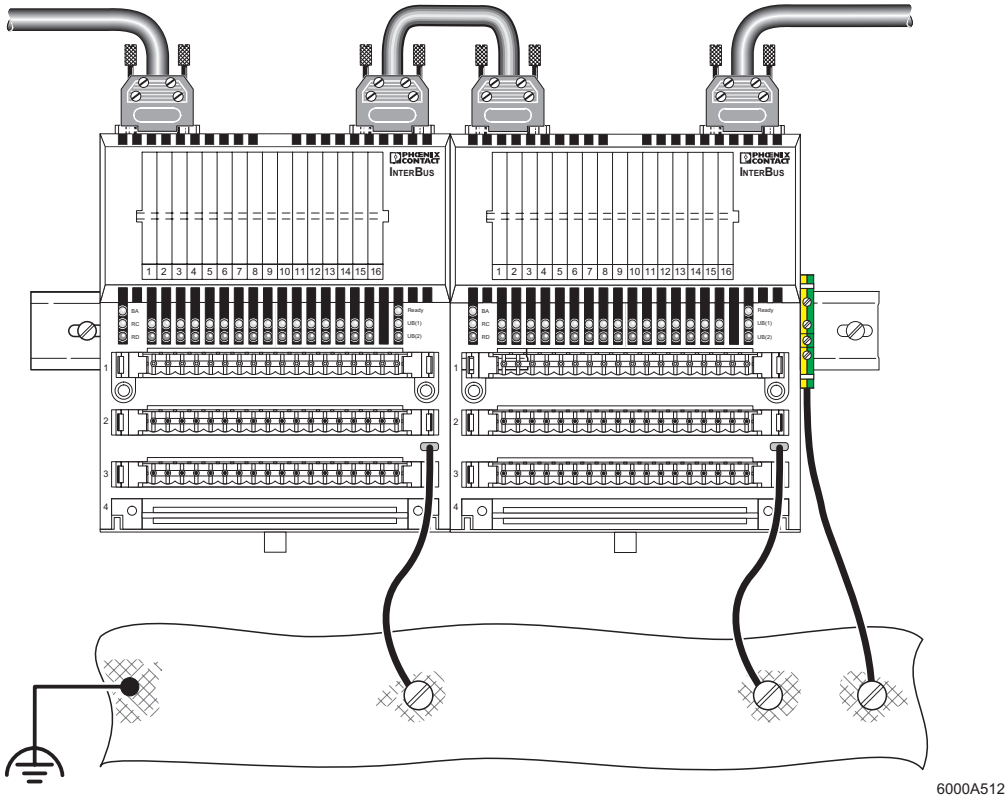


Figure 5-11 Rail mounting

Grounding

Ground the mounting rail correctly.

Connect the mounting rail with protective earth ground using a grounding terminal. The modules are grounded when they are snapped onto the mounting rail.

In addition, connect PE to the PE connection on the front right side of the module.

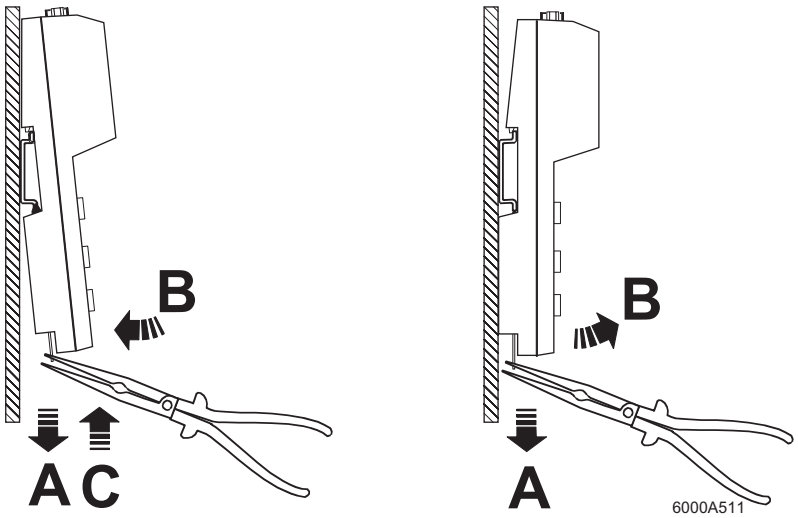


Figure 5-12 Rail mounting and removal

Mounting

Place the RT module onto the mounting rail from above. The connection terminals for the inputs/outputs are on the lower half of the module (Figure 5-12, left).

- Pull the metal strap on the bottom side of the RT module downwards using an appropriate tool (e.g., needle-nose pliers) (A).
- Swivel the bottom side of the module towards the mounting surface (B).
- Push the metal strap upwards until it snaps into place with a click (C). Now the module is placed correctly on the mounting rail.
- After installation, check the connection to the protective conductor for low-resistance continuity.

A stopper that is integrated in the backplane of the module prevents the module from sliding sideways.

Removal

To remove the module from the mounting rail, do the following (see Figure 5-12, right).

- Pull the metal strap on the bottom side of the module downwards (A).
- Swing the bottom side of the module away from the mounting surface (B).
  Lift the module off the mounting rail.

Direct Mounting

Please refer to "RT Module Dimensions" on page 5-13 for housing dimensions and drill hole distances.

The mounting surface must be flat to avoid strain on the modules.

Grounding

Ground the mounting surface correctly.

The RT modules can be mounted directly on the mounting surface using two fixing screws (e.g., M4 x 25 mm [0.984 in.] with two washers max. ∅ 8 mm [0.315 in.]). The mounting screws ensure a secure ground connection of the module to the conductive mounting surface (e.g., machine housing).

5.6 Connecting the Remote Bus

INTERBUS uses a 6-wire cable that is available by the meter (IBS RBC METER-T, Order No. 28 06 28 6)

For more detailed information, please refer to "Assembling D-SUB Connectors" on page 2-20.

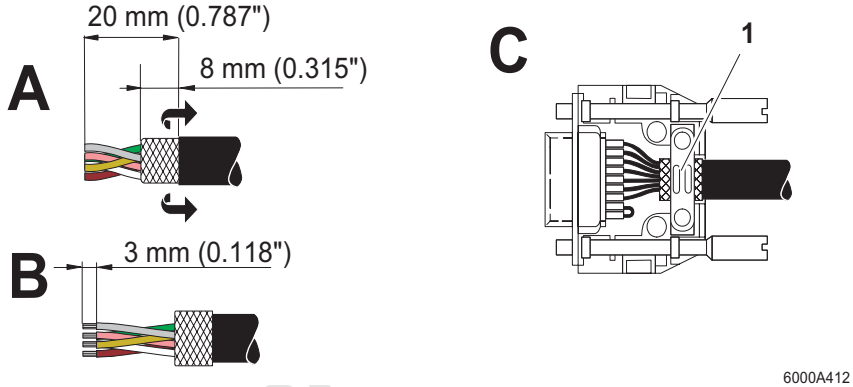


Figure 5-13 Connecting the remote bus cable

- Strip 20 mm (0.787 in.) off the cable sheath (Figure 5-13; A).
- Shorten the braided shield to 8 mm (0.315 in.).
- Fold the shielding uniformly back over the sheath.
- Strip 3 mm (0.118 in.) off the wires. Cut off the white wire as it is not required (Figure 5-13; B).
- Connect the wires to the contacts.
- Clamp the shield under the strain relief (1) to create a conductive connection with the housing (Figure 5-13; C).

Pin assignment

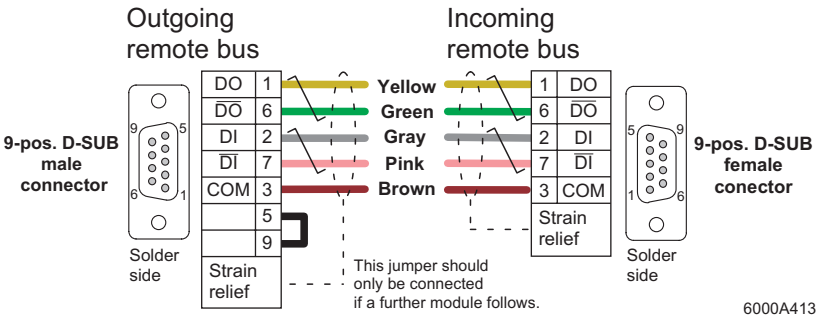


Figure 5-14 D-SUB connector pin assignment

Contacts 5 and 9 must be jumpered in the outgoing remote bus male connector.

5.7 Common Technical Data

This data is valid for the preferred mounting position (horizontal).

The technical data does not claim to be complete. Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Ambient Conditions	
Regulations	Developed according to VDE 0160, UL 508
Ambient temperature	Operation: 0°C to 60°C (32°F to 140°F) Storage and transport: -25°C to +75°C (-13°F to +167°F)
Humidity	Operation: 75% (no condensation) Storage: 85% (no condensation)
Air pressure	Operation: 80 kPa to 106 kPa (up to 2000 m [6562 ft.] above sea level)
Ventilation	Hanging module, natural convection
Degree of protection	IP 20, IEC 60536
Class of protection	Class 3 according to VDE 0106, IEC 60536
Air and creepance distances	According to IEC 60644/ IEC 60664A/ DIN VDE 0110: 1989-01 and DIN VDE 0160: 1988-05
Housing material	PA6.6 V0, self-extinguishing (V0)
Vibration test	2g, 19.6 m/s² at 55 Hz (Test conditions: 10 cycles per axis, frequency change of 1 octave per minute), (IEC 60068-2-6)
Shock test	15g, 147m/s² at 55 Hz (Test conditions: 3 impulses per axis and direction), (IEC 60068-2-27)

I/O Supply Voltage (U_S)	
Nominal value	U_S = 24 V DC
Special variants	120 V AC (IBS RT 120 DI 16-T) 230 V AC (IBS RT 230 DI 16-T) 120 to 230 V AC (IBS RT 120/230 DO 16-T)
Ripple	U_{PP} = 2.4 V within the permissible voltage range
Permissible voltage range	20 V DC to 30 V DC, ripple included

Connection Type	
Remote bus	9-pos. D-SUB connector
I/O connection	Rows 1 to 3: pluggable COMBICON connectors Row 4: bus bar with screw-clamp or spring-clamp terminals

Data Interface to INTERBUS	
Cable lengths	Max. 400 m (1315.360 ft.) between two devices
Error evaluation	Diagnostic and status indicators
Electrical isolation	Module-specific

Ordering Data

Description	Order Designation	Order No.
Analog input module with eight inputs	IBS RT 24 AI 8-T	27 23 19 4
Analog input/output module with four inputs and two outputs	IBS RT 24 AIO 4/2-T	27 53 00 9
Analog output module with four outputs	IBS RT 24 AO 4-T	27 23 18 1
Bus terminal module with remote bus branch	IBS RT 24 BK RB-T	27 50 48 4
Digital input module with 16 inputs	IBS RT 24 DI 16-T	27 53 59 1
Digital input module with 32 inputs	IBS RT 24 DI 32-T	27 52 74 1
Digital input/output module with 16 inputs and 16 outputs	IBS RT 24 DIO 16/16-T	27 53 60 1
Digital input/output module with 16 inputs and 2 outputs	IBS RT 24 DIO 16/8-2A-T	27 23 17 8
Digital input/output module with eight inputs and eight relay outputs	IBS RT 24 DIO 8/8R-T	27 53 61 4
Digital output module with 16 outputs	IBS RT 24 DO 16-T	27 53 64 3
Digital output module with 32 outputs	IBS RT 24 DO 32-T	27 52 75 4
Digital input module with 16 inputs for 120 V AC	IBS RT 120 DI 26-T	27 50 45 5
Digital output module with 16 outputs for 24 V AC to 230 V AC	IBS RT 120/230 DO16-T	27 50 46 8
Digital input module with 16 inputs for 230 V AC	IBS RT 230 DI 16-T	27 50 47 1

Ordering Data (Accessories)

Description	Order Designation	Order No.
COMBICON screw-clamp terminals, 2.5 mm² (14 AWG)	IBS RT PLSET SMSTB	18 50 43 7
COMBICON spring-clamp terminals, 1.5 mm² (16 AWG)	IBS RT PLSET FK-MSTBP	18 50 42 4
Potential terminal strip, screw-clamp terminals, single-row	IBS RT P-MKDSN/1	22 91 21 5
Potential terminal strip, screw-clamp terminals, double-row	IBS RT P-SMKDSN/2	22 91 23 1
Potential terminal strip, screw-clamp terminals, triple-row	IBS RT P-SMKDSN/3	22 91 25 7
Potential terminal strip, spring-clamp terminals, single-row	IBS RT P-FFKDS/1	22 91 22 8
Potential terminal strip, spring-clamp terminals, double-row	IBS RT P-FFKDS/2	22 91 24 4
Potential terminal strip, spring-clamp terminals, triple-row	IBS RT P-FFKDS/3	22 91 26 0
9-pos. D-SUB female connector	SUBCON 9/F-SH	27 61 49 9
9-pos. D-SUB male connector	SUBCON 9/M-SH	27 61 50 9
INTERBUS cable, preassembled, 20 mm (0.787 in.)	IBS RBC RT-KONFEK-T	27 53 62 7

For varying module data, please refer to the corresponding data sheet or the INTERBUS catalog.

Section 6

This section informs you about

– the module overlapping properties of CT coupling modules

6 CT-I/O Gateways (Configurable Terminals)

6.1 Product Description

CT-I/O gateways are compact input/output units. CT-I/O gateways can be directly installed in the remote bus.

INTERBUS CT-I/O gateways connect two INTERBUS systems for exchanging data on the input/output level (see Figure 6-1). CT-I/O gateways have the same function as two I/O modules on which the inputs and outputs are connected crosswise. This way it is possible to transmit data from one system part to the other. The data width is freely configurable between one byte and ten words by means of a rotary switch.

CT-I/O gateways can be combined with all INTERBUS-compatible devices.

Types

The product family of the CT-I/O gateways has the following module types:

– Gateway for 2 INTERBUS rings, remote bus connections with MINI-COMBICON
– Gateway for 2 INTERBUS rings, remote bus connections with fiber optics

Positioning

CT-I/O gateways (IP 20 protection) are used for applications in closed control cabinets. Due to their compact design, CT-I/O gateways are used for installations in cable ducts or in small control cabinets.

CT-I/O gateways are designed for a wide temperature range (-20°C to +70°C [-4°F to +158°F])

Mounting

CT-I/O gateways are mounted on standard mounting rails. The CT-I/O gateways are grounded when they are mounted on the mounting rail.

Bus connection

The bus connections of CT-I/O gateways can be either shielded, twisted-pair signal lines or fiber optics.

– CT-I/O gateways with conventional remote bus connection:
  The bus connection and the connection of the supply voltage are pluggable by means of MINI-COMBICON screw-clamp terminals.
– CT-I/O gateways with fiber-optic connection:
  The bus is connected with F-SMA connectors. The supply voltage for the electronics module is pluggable by means of COMBICON screw-clamp terminals.

6.2 Structure

6.2.1 Structure of a System With CT-I/O Gateways

System With Copper Wires

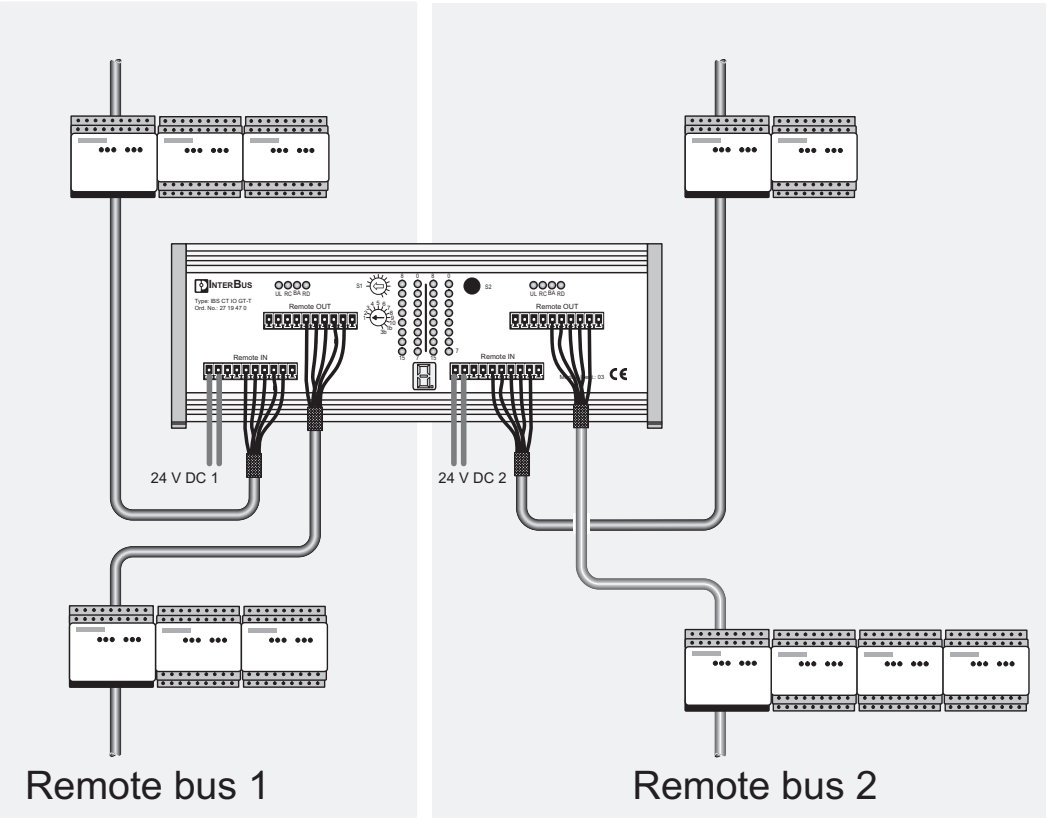


Figure 6-1 Installation example (IBS CT 24 IO GT-T)

System With Fiber Optics

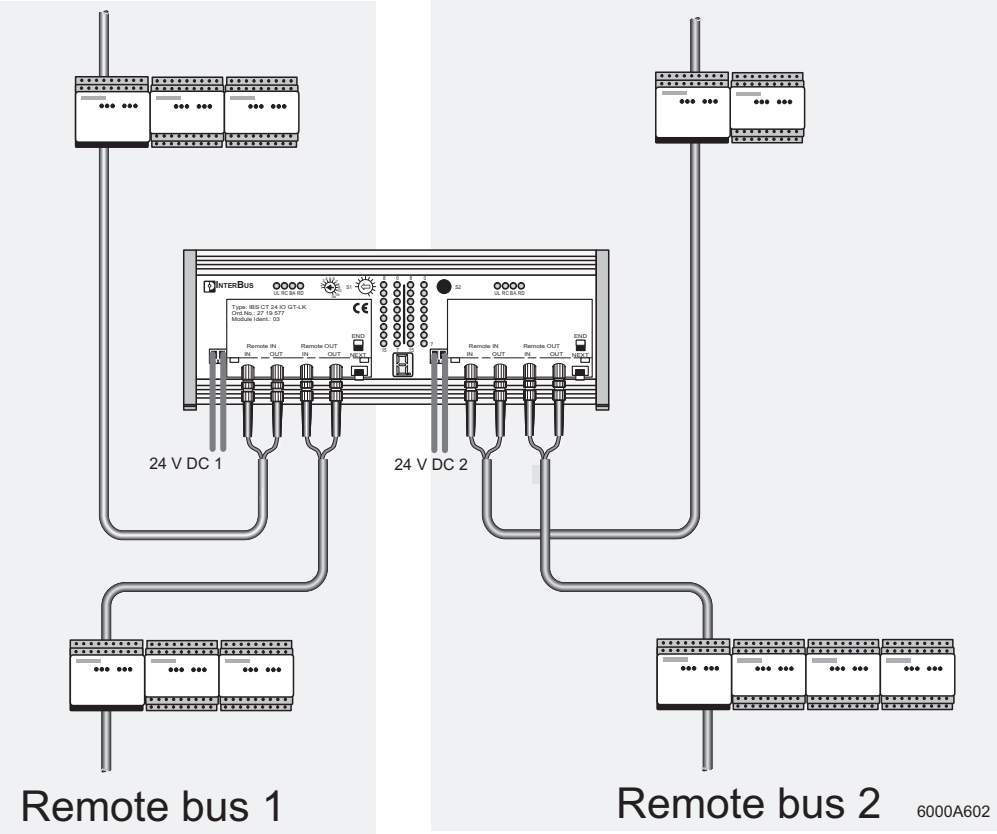
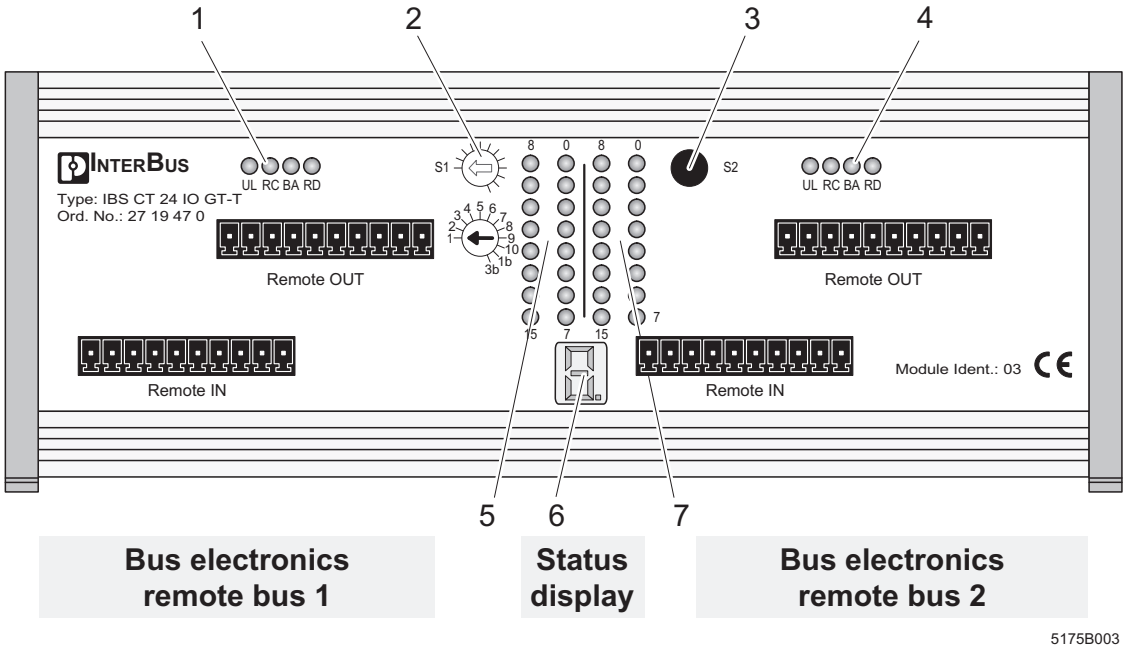


Figure 6-2 Installation example (IBS CT 24 IO GT-LK)

6.2.2 Structure of a CT-I/O Gateway



5175B003

Figure 6-3 Front view (IBS CT 24 IO GT-T)

1 Diagnostic indicators for remote bus 1

2 Configuration switch S1

3 Pushbutton S2 (selection of the word or byte number of the INTERBUS output data)

4 Diagnostic indicators for remote bus 2

5 Status indicators for remote bus 1

6 7-segment display

7 Status indicators for remote bus 2

6.3 Diagnostic and Status Indicators

The diagnostic and status indicators of the CT-I/O gateways allow for quick local error diagnostics.

Diagnostics

The diagnostic indicators (red/green) indicate the type and location of the error. The CT-I/O gateway is functioning correctly if all of the green LEDs are on.

UL	Green LED	Supply voltage of the module electronics
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present – Internal power supply unit defective
RC	Green LED	Remote bus connection (remote bus check)
	ON:	Incoming remote bus connection established
	OFF:	Incoming remote bus connection defective
BA	Green LED	Bus active (remote bus active)
	ON:	Data transmission on INTERBUS active
	OFF:	No data transmission
	As of G4 Flashing:	Bus active, but no cyclic data transmission
RD	Red LED	Remote bus disabled
	ON:	Outgoing remote bus switched off
	OFF:	Outgoing remote bus switched on

Status

The status indicators (yellow) indicate the state of the output data word (or byte) of the corresponding remote bus that was selected with the S2 push-button.

XX	Yellow LEDs	State of the INTERBUS output word of the corresponding remote bus
	ON:	Bit is set, i.e., logic state "1"
	OFF:	Bit is not set, i.e., logic state "0"

6.4 Mounting CT-I/O Gateways

6.4.1 Mounting Distances

The CT-I/O gateways can be mounted (on the mounting rail) with their short sides next to each other.

Keep at least 50 mm (1.969 in.) free, above and below the BK module, for ventilation and cabling.

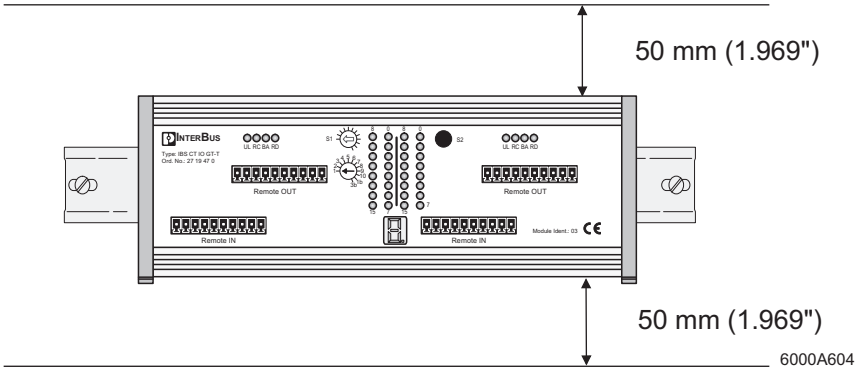


Figure 6-4 Mounting distances of CT-I/O gateways

6.4.2 Dimensions of CT-I/O Gateways

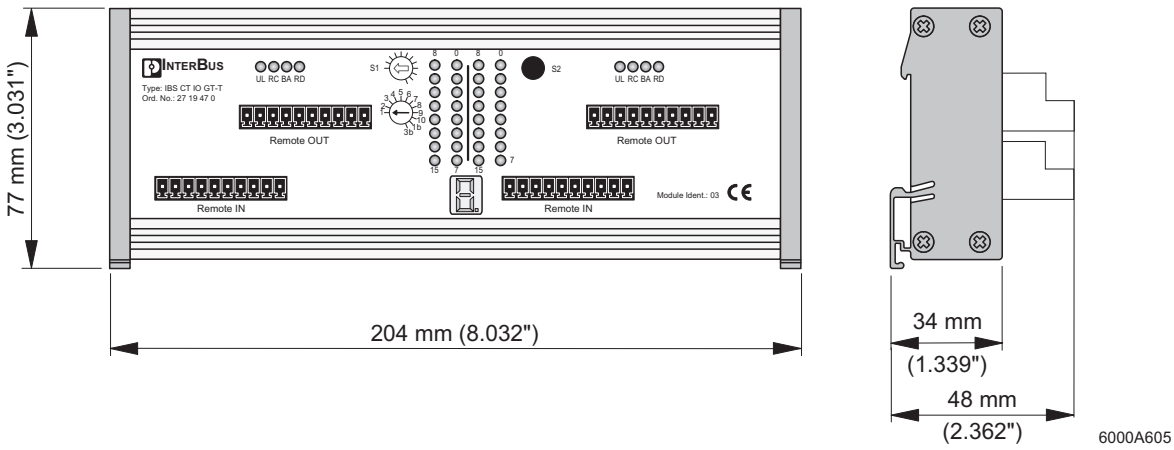


Figure 6-5 Dimensions of CT-I/O gateways

6.4.3 Mounting CT-I/O Gateways

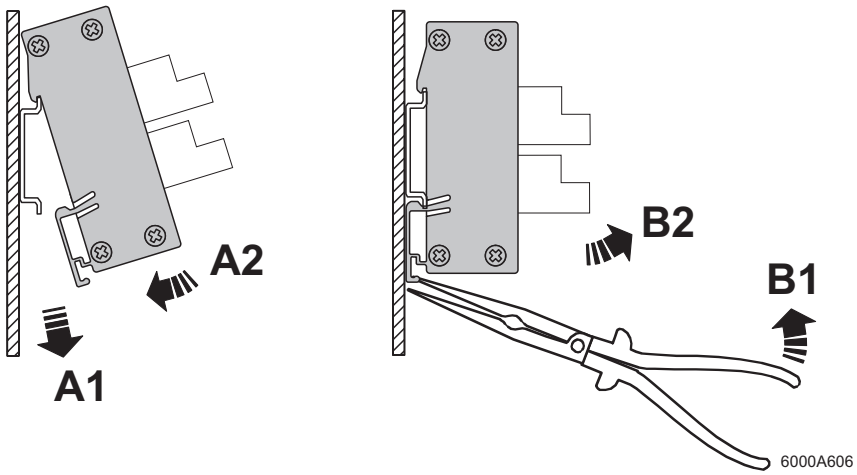


Figure 6-6 Rail mounting and removal

Grounding

Install a clean and corrosion-free mounting rail (DIN EN 50022, Phoenix Contact: Order Designation NS 35) on the mounting surface.

Connect the mounting rail to protective earth ground with a grounding terminal. The modules are grounded when they are snapped onto the mounting rail.

Mounting position

The mounting position can be as desired.

Mounting

– Place the module onto the mounting rail from above (Figure 6-6; A1).
– Push the module towards the mounting surface (Figure 6-6; A2).
– Secure the module to the right and to the left with end clamps or grounding terminals.

Removal

– For removal, insert an appropriate tool into the latch (Figure 6-6; B 1).
– Pull the tool upwards.
– Pull the module off in vertical direction to the rail (Figure 6-6, B 2).

6.5 Connecting the Remote Bus

6.5.1 Connecting a Remote Bus With MINI-COMBICON

Fit the MINI-COMBICON male connectors that are also supplied to the remote bus cable.

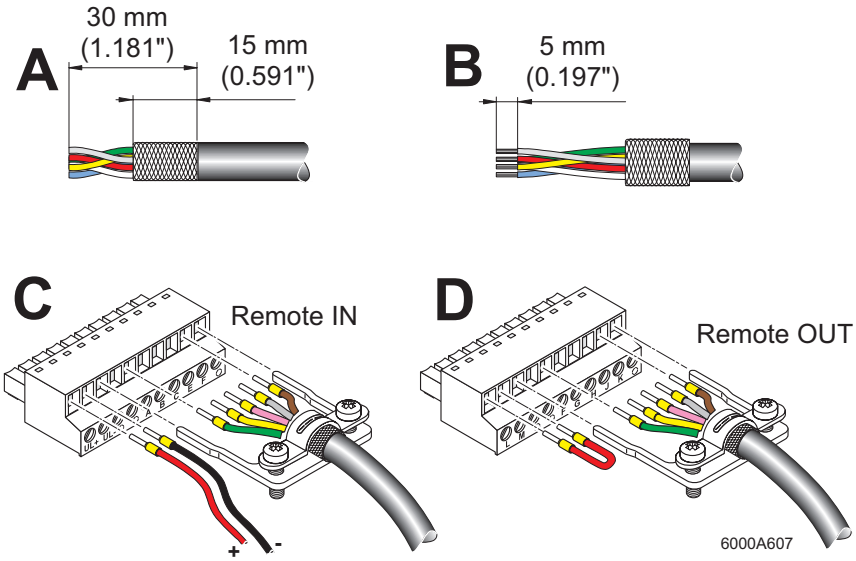


Figure 6-7 Assembling MINI-COMBICON male connectors

– Strip approx. 30 mm (1.181 in.) off the outer cable sheath (Figure 6-7; A).
– Shorten the braided shield to 15 mm (0.591 in.) (Figure 6-7; A) and place it around the outer cable sheath (Figure 6-7; B).
– Remove the protective foil.
– Cut off the white wire close to the outer cable sheath, as it is not required.
– Strip approx. 5 mm (0.197 in.) off the wires (Figure 6-7; B).
– Crimp ferrules to the end of the wires.
– Wire the corresponding connectors according to the following figure.

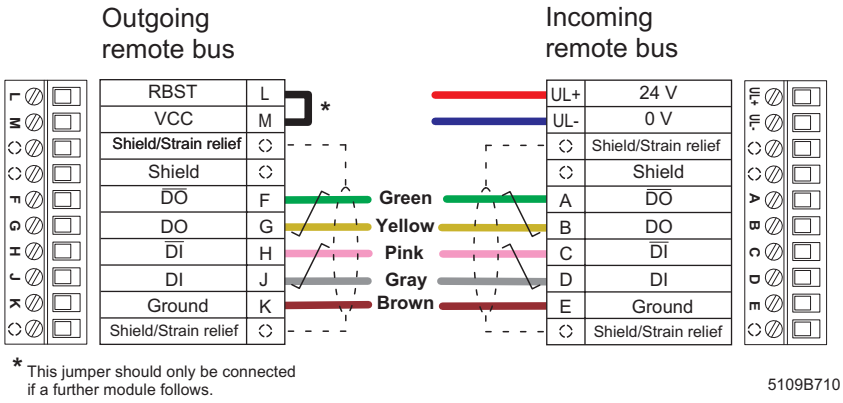


Figure 6-8 Pin assignment of the MINI-COMBICON connectors

A jumper must be installed between the contacts L and M of the outgoing remote bus connector (Remote OUT). The jumper indicates that another module follows.

Connect both supply voltages so that if one remote bus line fails the other remote bus line continues to operate.

– The supply voltage U_L for the module electronics must be supplied through the terminals 1 (U_L+) and 2 (U_L-) of the REMOTE IN connector as it is not carried in the bus cable.
– Connect the shield clamp to contacts 3 and 10 of the connector. The clamp ensures proper strain relief (Figure 6-7; C or D).
– Fasten the shield clamp so that as much of the braided shield as possible is held underneath the clamp.

Plugging the MINI-COMBICON Connectors

– Plug the connectors into the corresponding terminal strips, so that the keying tabs match.

Remote IN designates the incoming remote bus.
Remote OUT designates the outgoing remote bus.

6.5.2 Connecting a Remote Bus Using Fiber Optics

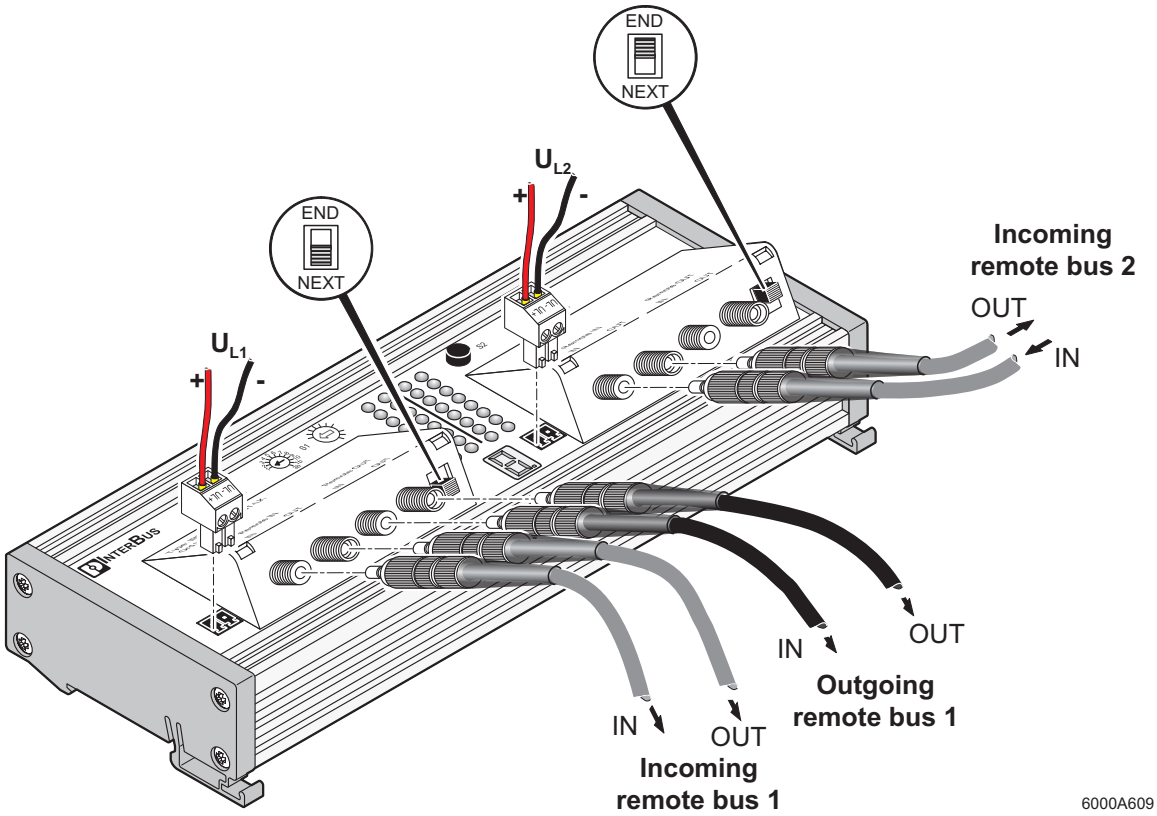


Figure 6-9 Connecting the bus with fiber optics

If a module is connected to a remote bus out, the NEXT-END switch must be set to NEXT. If no module is connected to a remote bus out, the switch must be set to END.

Refer to the package slips of the F-SMA connectors and the "Optical Fiber Installation Guidelines" (DB GB IBS SYS FOC ASSEMBLY, Part No. 94 23 43 9) when assembling fiber optics.

– Fit the corresponding F-SMA connectors to the fiber-optic cables.
– Plug the connectors into the sockets provided.
– Secure the connections with cap nuts.
– Connect the supply voltage U_L for the module electronics with the 2-pos. MINI-COMBICON connectors.

Connect both supply voltages so that if one remote bus line fails the other remote bus line continues to operate.

Remote IN designates the connections for the incoming remote bus. Remote OUT designates the connections for the outgoing remote bus. IN and OUT indicate on which connection data is received (IN) and sent (OUT).

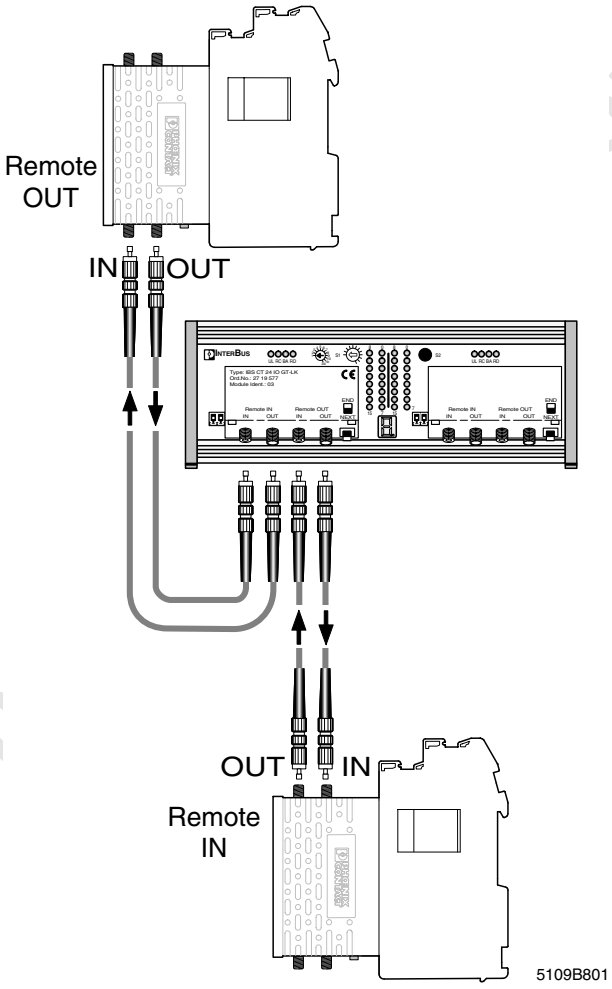


Figure 6-10 Fiber-optic connection between two modules

6.6 Common Technical Data

The technical data does not claim to be complete. Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Ambient Conditions	
Regulations	Developed according to VDE 0160, UL 508
Ambient temperature	Operation: -20°C to +70°C (-4°F to +158°F) Storage: -40°C to +85°C (-40°F to +185°F)
Humidity	Operation: 30% to 75% (no condensation) Storage/transport: 30% to 95% (no condensation)
Air pressure	Operation: 86 kPa to 108 kPa (up to 1500 m [4921ft.] above sea level) Storage/transport: 66 kPa to 108 kPa (up to 3500 m [11483 ft.] above sea level)
Ventilation	Hanging module, natural convection
Degree of protection	IP 20, IEC 60529
Class of protection	Class 3 according to VDE 0106, IEC 60536
Air and creepance distances	According to IEC 60644/ IEC 66064A/ DIN VDE 0110: 1989-01 and DIN VDE 0160: 1988-05
Housing material	Anodized aluminum, PA6.6 V0, self-extinguishing (V0)
Vibration test	2g (19.6 m/s^2) at 55 Hz Test conditions: 10 cycles per axis, Frequency change of 1 octave/min (IEC 60068-2-6)

Supply Voltage (U_S)	
Nominal voltage	U_S = 24 V DC
Ripple	U_{PP} = 3.6 V (maximum) within the permissible voltage range
Permissible voltage range	18.5 V DC to 30.5 V DC, ripple included
Overvoltage protection	> 35 V (0.5 s)

Connection Type	
Remote bus	– Copper: 10-pos. MINI-COMBICONconnector – Fiber optic: for each transmission channel (IN/OUT) one F-SMA connector coupling (outgoing remote bus can be switched off by means of the NEXT-END switch)

Data Interface to INTERBUS	
Cable lengths	– Copper: maximum 12.8 km (7.954 mi.) from the controller board to the last remote bus device Max. 400 m (1312.336 ft.) between two devices – Fiber optic: depending on the material used
Error evaluation	Diagnostic and status indicators
Error message	Module error and controller board
Electrical isolation	Remote bus 1 and remote bus 2 (500 V AC test voltage, 50 Hz, 1 min. or through fiber optic) Communications (U_L) and 24 V (U_S) supply (500 V AC test voltage, 50 Hz, 1 min.)

Ordering Data

Description	Order Designation	Order No.
I/O gateway with fiber-optic connections	IBS CT 24 IO GT-LK	27 19 57 7
I/O gateway with connections for copper cable	IBS CT 24 IO GT-T	27 19 47 0

Ordering Data (Accessories)

Description	Order Designation	Order No.
Replacement shield clamp	IBS RB-SHIELD	27 22 74 2
Replacement connector set for the remote bus	IBS RB PLSET/FRONT-MC 1,5/10	27 22 76 8

For varying module data, please refer to the corresponding data sheet.

Section 7

This section informs you about

– the module overlapping properties of sensor/actuator boxes (SAB modules)

7 Sensor/Actuator Boxes (SAB)

7.1 Product Description

The sensor/actuator boxes (SAB) are compact I/O units with remote bus function. SABs can be directly connected to the remote bus or installation remote bus.

Sensor/actuator boxes are used for applications with only a few input/output points. They can be combined with all INTERBUS-compatible devices.

Types

Modules are available with digital input/output functions:

- 4 digital inputs
- 8 digital inputs
- 16 digital inputs
- 8 digital outputs
- 4 digital inputs/2 digital outputs
- 4 digital inputs/4 digital outputs

Positioning

Sensor/actuator boxes can be used locally. They can be installed into systems or machines without a control cabinet (IP 67 protection).

Mounting

Sensor/actuator boxes are directly screwed down on a mounting surface or mounted on aluminum mounting profiles. The modules are grounded with a functional earth ground connection on the outside of the housing.

Bus connection

The bus cable is led into the connector hood through PG9-threaded joints and MINI-COMBICON connectors.
The voltage supply for the module electronics can be connected with a hybrid cable (installation remote bus) or supplied separately.

Transmission medium

SABs can only be connected using copper wires.

I/O connection

The inputs/outputs are connected to the I/O modules using 5-pos. M12 connectors.

The sensors can be connected using the 4-wire connection method (signal, U_S, 0 V, functional earth ground). The actuators can be connected using the 3-wire connection method (signal, 0 V, functional earth ground).

7.2 Structure

7.2.1 Structure of Systems with Sensor/Actuator Boxes

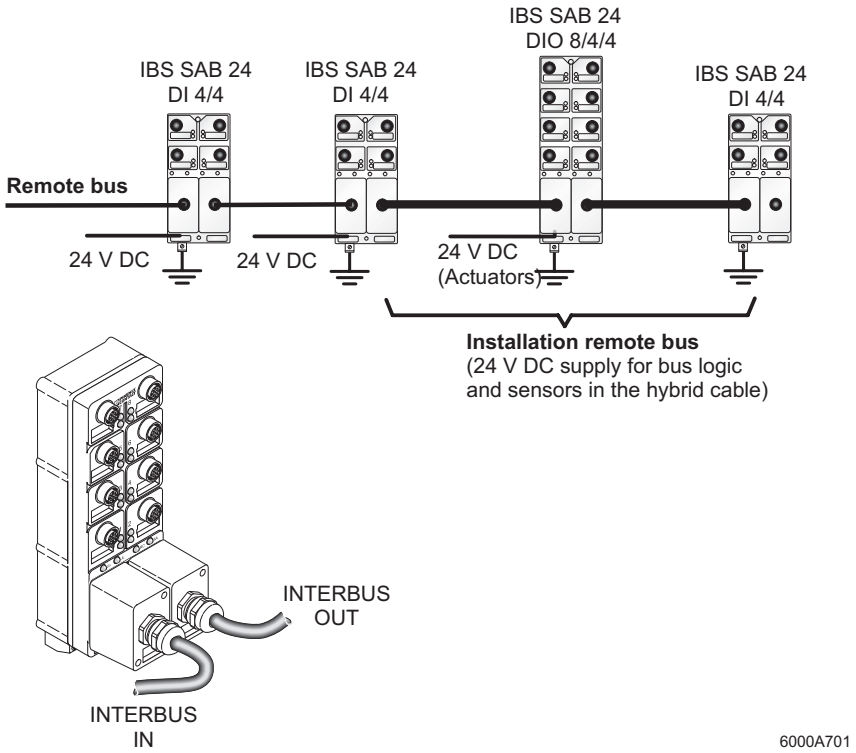


Figure 7-1 Example system structure

Sensor/actuator boxes can be used in the remote bus and in the installation remote bus.

– Installation remote bus
  The power supply for the bus logic and sensors is carried in the hybrid cable. The actuators are supplied separately.
– Remote bus
  The power supply for the bus logic, sensors and actuators is supplied separately.

Lead the supply voltages for the incoming remote bus through the openings in the connector hood.

7.2.2 Structure of a Sensor/Actuator Box

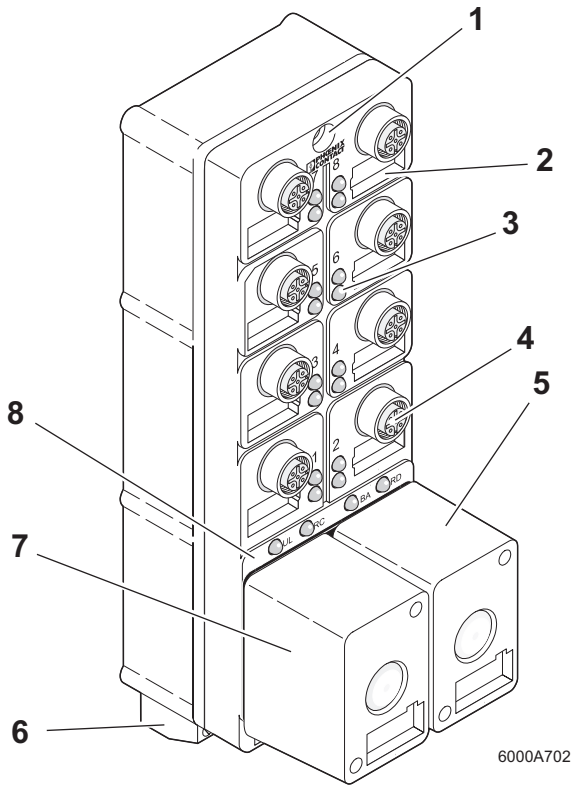


Figure 7-2 Example structure of a sensor/actuator box

1 Top fixing hole
2 Slot for labeling field
3 Status indicators for inputs and outputs
4 Digital inputs/outputs (M12 circular connector, 5-pos.)
5 Connector hood, outgoing remote bus (INTERBUS OUT)
6 Functional earth ground connection
7 Connector hood, incoming remote bus (INTERBUS IN)
8 Diagnostic indicators

7.3 Diagnostic and Status Indicators

The diagnostic and status indicators of the sensor/actuator boxes allow for quick local error diagnostics.

The LEDs listed below are typical for sensor/actuator boxes, but not all of the LEDs are on every module. Depending on the module type, additional LEDs can indicate the operating state of the module.

For additional information on the diagnostic and status indicators please refer to the data sheet of the corresponding module.

Diagnostics

The diagnostic indicators (red/green) indicate the type and location of the error. A sensor/actuator box is functioning correctly if all of the green LEDs are on.

UL	Green LED	Supply voltage of the module electronics
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present – Fuse blown in BK module – Internal power supply unit defective – Incoming INTERBUS cable not plugged in
RC	Green LED	Remote bus connection (remote bus check)
	ON:	Incoming remote bus connection established
	OFF:	Incoming remote bus connection defective
BA	Green LED	Bus active (remote bus active)
	ON:	Data transmission on INTERBUS active
	OFF: As of G4	No data transmission
	Flashing:	Bus active, but no cyclic data transmission
RD	Red LED	Remote bus disabled
	ON:	Outgoing remote bus switched off
	OFF:	Outgoing remote bus switched on

Status

The status indicators (yellow) indicate the signal state of the corresponding inputs/outputs. If the yellow status LEDs are on, this indicates the signal state "1" of the input/output signal.

X	Yellow LED	Status of the input/output signal
	ON:	Input/output active, i.e., logic state "1"
	OFF:	Input/output inactive, i.e., logic state "0"

7.4 Mounting Sensor/Actuator Boxes

Sensor/actuator boxes are mounted directly on mounting angles or mounting plates.

7.4.1 Mounting Distances

Keep 50 mm (1.969 in.) free above and below the module for the cabling. Keep 32 mm (1.260 in.) free to the right and left of the module.

A distance of 150 mm (5.906 in.) (measured from the bottom edge of the module) must be kept between the module and a cabinet door or cover.

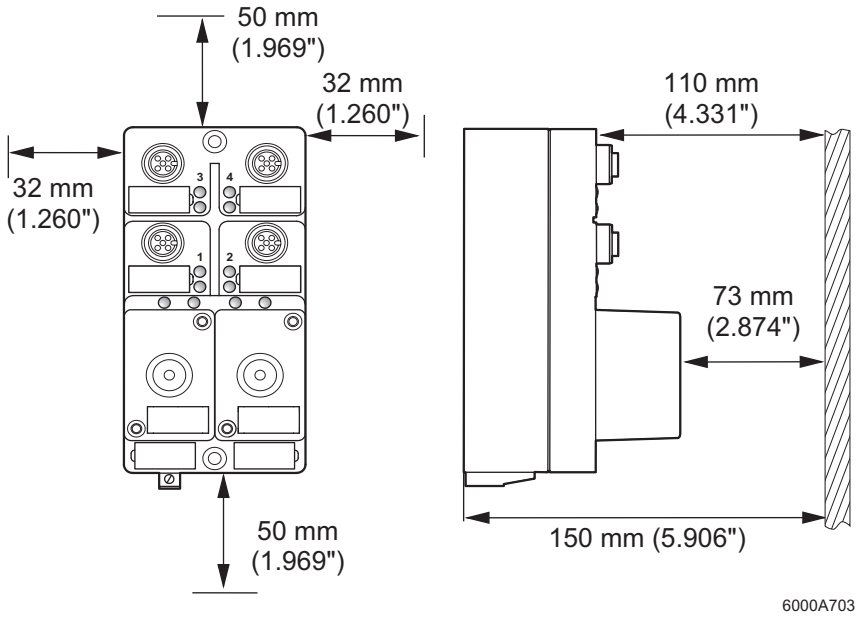


Figure 7-3 Mounting distances of sensor/actuator boxes

7.4.2 Dimensions of Sensor/Actuator Boxes

The product family of sensor/actuator boxes has two housing types with 4 or 8 sockets.

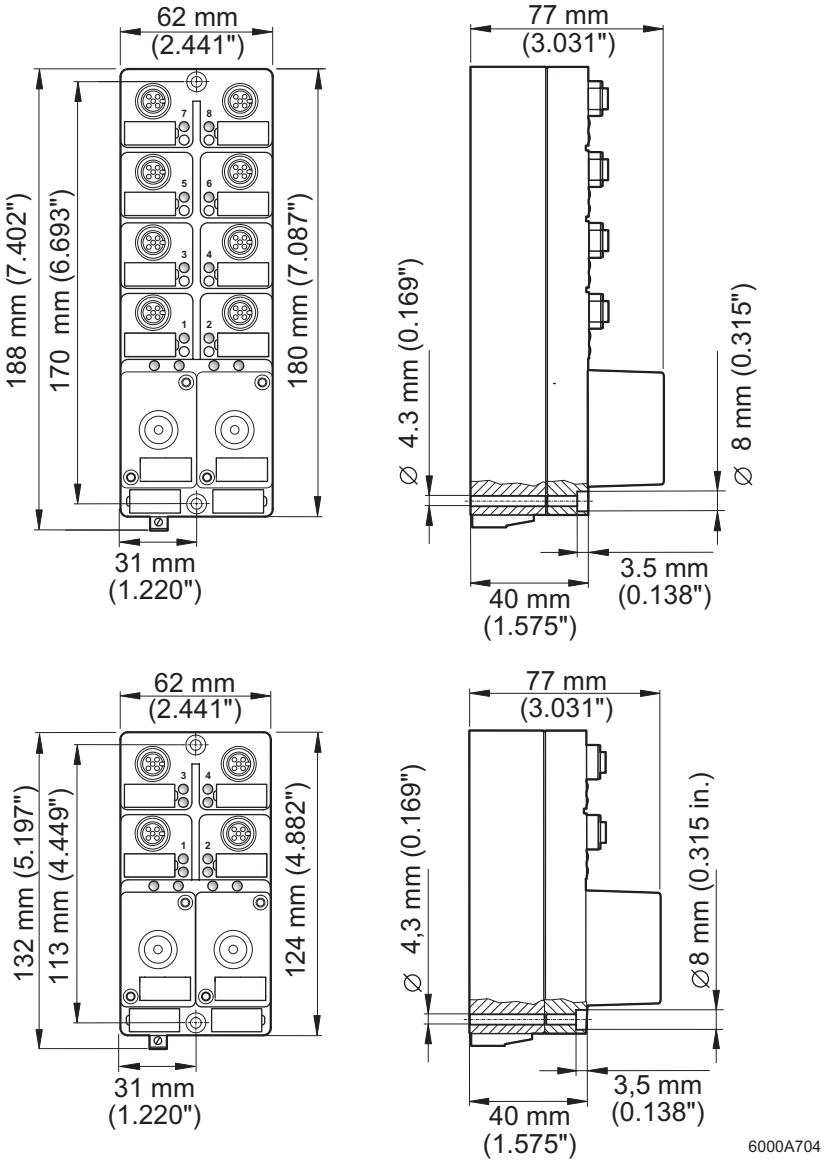


Figure 7-4 Dimensions of an SAB with 8 or 4 sockets

7.4.3 Mounting Sensor/Actuator Boxes

Sensor/actuator boxes are mounted directly on mounting angles or mounting plates.

The mounting surface must be flat to avoid strain on the modules.

Grounding

Ground the module by using the functional earth ground connection. If the FE potential is connected in the installation remote bus, connecting this terminal is not essential.

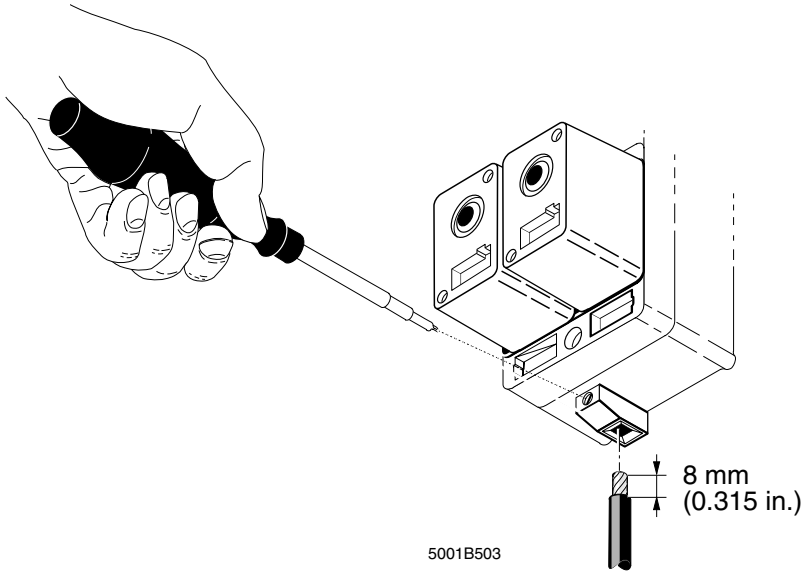


Figure 7-5 Installation of the grounding

– Strip approx. 8 mm (0.315 in.) off a green/yellow grounding cable with cross section of 2.5 mm^2 to 4 mm^2 (14 to 12 AWG).
– Connect the grounding cable to the screw-clamp terminal.

Mounting

Properly terminate all I/O and bus connections to ensure environmental protection of the module. Protect all unused connectors with protective caps.

– Fasten the sensor/actuator boxes to the mounting surface using two screws and two washers with a maximum outside diameter of 8 mm (0.315 in.).

7.5 Connecting the Remote Bus and the Supply Lines

The remote bus and the supply lines are connected in the same way.

Use the available cable opening on the side or top of the connector hood of the incoming bus connector for the connection of the voltage supply of the actuators and/or bus logic.

If you connect an installation local bus and do not require actuator supply you only need one cable opening. In all other cases both cable openings must be used.

The PG-9 threaded joints for the bus connection are available as an accessory (SAB-CG/PG 9, Order No. 16 62 13 3).

Preparing the Connector Hood

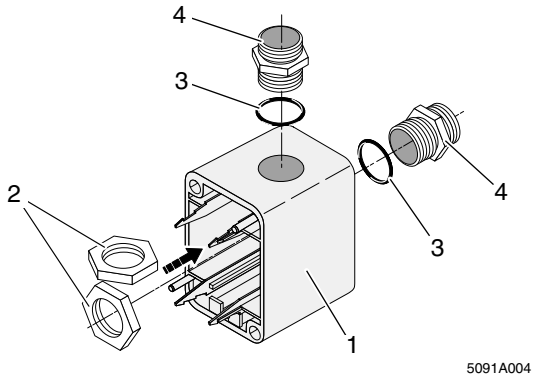


Figure 7-6 Fitting the threaded joints

- Remove the two screws of the connector hood and remove the connector hood.
- Use a screwdriver to break the cable openings out of the connector hood (1).
- Push the O-ring (3) onto the threaded joint (4).
- Place the hexagonal metal nut (2) of the PG-threaded joint in the recess or in the slot of the connector hood (1).
- Tighten the cable gland until the end by turning the threaded joint (4) with a wrench (17 mm [0.669 in.]).

Assembling a Cable and Leading It Through the Connector Hood

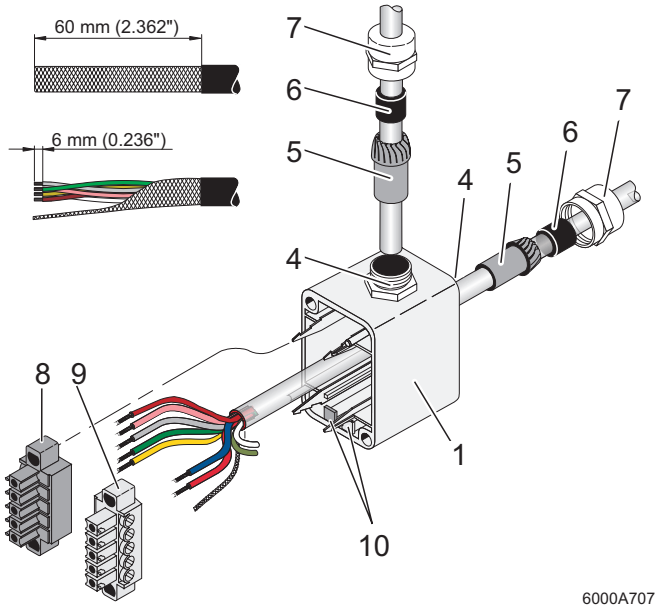
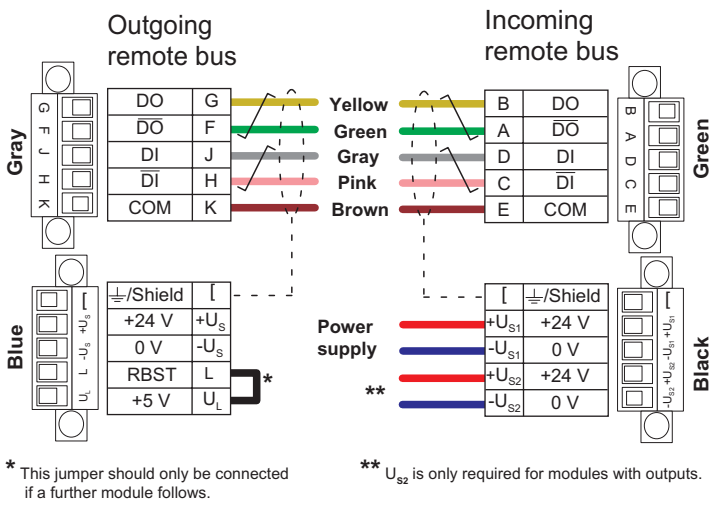


Figure 7-7 Assembling the components of the connector hood

– Push the following parts onto the cable:
  Cap (7), flexible ring (6), strain relief (5),
  connector hood with the threaded joint (1 and 4)
– Strip 60 mm (2.362 in.) off the outer cable sheath.
– Remove the braided shield from the wires and twist as much of it as possible together to form one wire.
– Cut off the white wire close to the outer cable sheath, as it is not required.
– Strip approx. 6 mm (0.236 in.) off the wire ends.
– Twist the wire consisting of the braided shield and the green/yellow ground conductor together and insert both into one ferrule. (When the remote bus is installed without voltage supply, the ground connector is missing; in this case insert only the braided shield into the ferrule.)
– Fit ferrules at the end of the other wires.
– Push the wires into the contacts of the MINI-COMBICON connector (8 or 9) and tighten the connections with a screwdriver.

Wiring MINI-COMBICON Connectors

Remote bus



Installation remote bus

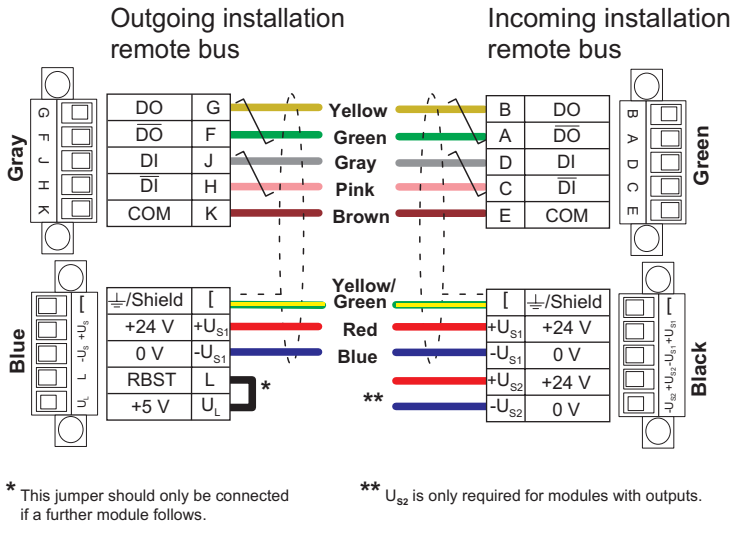


Figure 7-8 MINI-COMBICON pin assignment

Mounting Strain Relief

Ensure the tightness of the opening to guarantee IP 67 protection of the module.

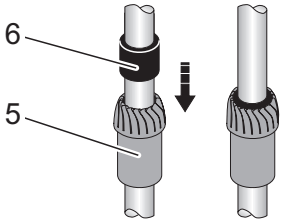


Figure 7-9 Strain relief with a flexible ring

– Push the flexible ring (6) into the strain relief (5).
– Push the strain relief (5) into the threaded joint (4) (see Figure 7-7).
– Pull the cable back so that the outer cable sheath is still visible from the inside of the connector hood.
– Fasten the cap (7) onto the threaded joint (4) by turning the cap with a wrench (17 mm [0.669 in.]) (see Figure 7-7).

Placing the Connector Hoods

Danger of damage to the module electronics!
Do not mix up the terminals, as this may damage the electronics.

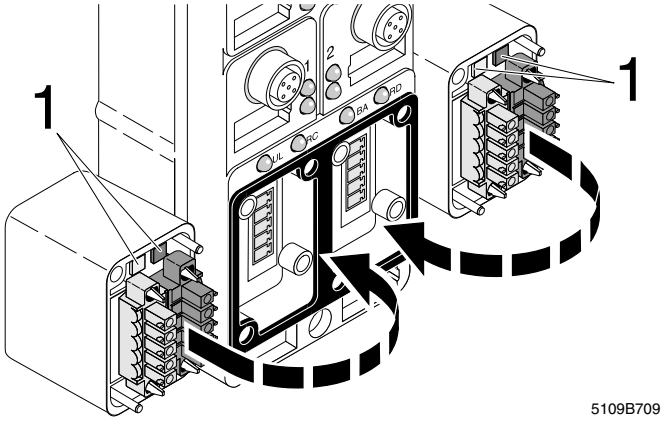


Figure 7-10 Placing the connector hoods

Table 7-1 Color assignment of the MINI-COMBICON connector

INTERBUS IN		INTERBUS OUT	
Green	GN	Gray	GY
Black	BK	Blue	BU

– Snap the wired MINI-COMBICON connectors onto the locking clips according to the color coding (1 in Figure 7-10).
– Fasten the connector hoods with the supplied screws.

7.5.1 Insufficient Power Supply

If the power supply at the last device is insufficient, this may be because the distance between the devices is too long. The maximum distance between two devices is 50 m (164.042 ft.). If necessary, provide a voltage source between the devices.

7.6 Connecting Sensors and Actuators

The connection of the sensors and actuators is shown in the module-specific data sheets because the assignment of the 5-pos. M12 female connectors varies depending on the module type.

7.6.1 Wiring the Sensor/Actuator Cables

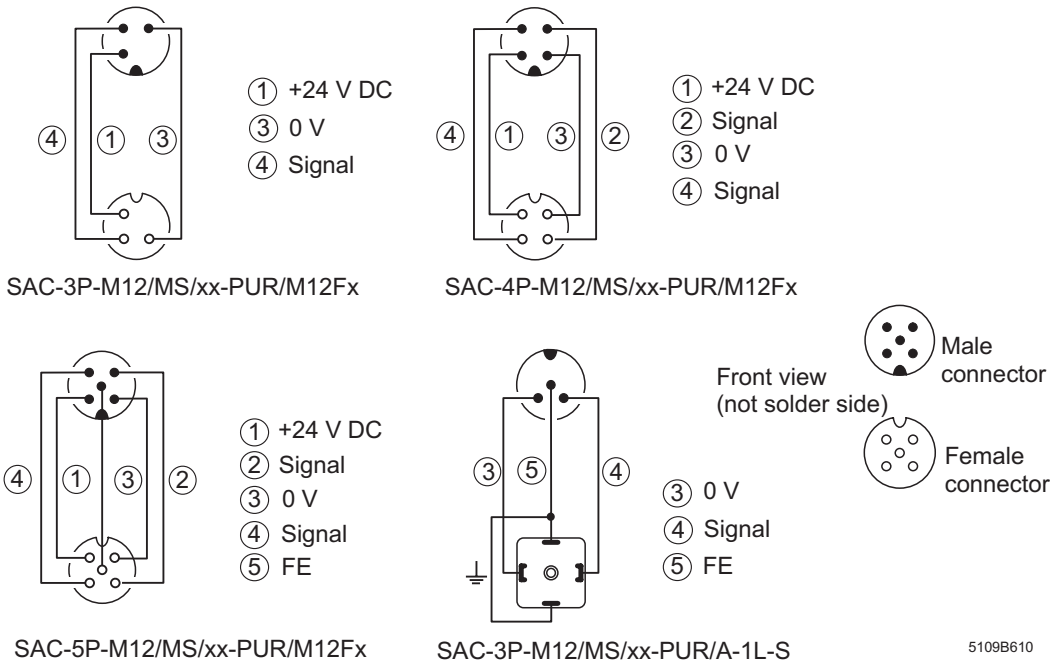


Figure 7-11 Pin assignment of the male and female connectors

For the meaning of the product designations please refer to the ordering data (see page 7-18).

7.7 Common Technical Data

The technical data does not claim to be complete. Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Ambient Conditions	
Ambient temperature	Operation: 0°C to +55°C [32°F to 131°F] (inlet air temperature) Storage: -25°C to +70°C (-13°F to +158°F)
Humidity	Operation: 100 % Storage: 95% (no condensation)
Air pressure	Operation: 80 kPa to 106 kPa (up to 2000 m [6562 ft.] above sea level) Storage: 66 kPa to 106 kPa (up to 3500 m [11483 ft.] above sea level)
Degree of protection	IP 67 (IEC 60536) with protective caps for unused sensor/actuator sockets
Air and creepance distances	According to IEC 60644/ IEC 60664A/ DIN VDE 0110: 1989-01 and DIN VDE 0160: 1988-05
Housing material	Polyamide 6.6 V0, self-extinguishing (V0)
Vibration test	5g, 10 Hz to 150 Hz, (IEC 60068-2-6) (Acceleration amplitude above the limit frequency)
Shock test	15g (IEC 60068-2-27)

Supply Voltage	
Nominal voltage	U_S = 24 V DC
Ripple	U_{PP} = 3.6 V within the permissible voltage range
Permissible voltage range	18.5 V DC to 30.2 V DC, ripple included
Current consumption from the installation remote bus	Maximum 100 mA + sensor supply
Current carrying capacity (The voltage U_{S1} is looped through and can be tapped off at the connector for the outgoing installation remote bus. The maximum continuous current is 4.5 A)	4.5 A

Connection Type	
Remote bus	Installation remote bus 2 × 5-pos. MC 1,5 (MINI-COMBICON)
I/O connection	5-pos. M12 circular connectors

Data Interface to INTERBUS	
Cable lengths	Installation remote bus Maximum 50 m (164.042 ft.) between two devices Maximum 50 m (164.042 ft.) between BK module and last device
Error evaluation	Diagnostic and status indicators
Electrical isolation	Supply voltage U_{S1}/remote bus Bus/inputs Supply voltage U_{S1}/functional ground (500 V AC test voltage, 50 Hz, 1 min.)
Equipotential bonding	U_L and U_S combined with each other

Ordering Data

Description	Order Designation	Order No.
Digital input module with four inputs	IBS SAB 24 DI 4/4	27 19 72 6
Digital input module with 16 inputs	IBS SAB 24 DI 8/16	27 31 67 8
Digital input module with eight inputs	IBS SAB 24 DI 8/8	27 53 51 7
Digital input/output module with four inputs and two outputs	IBS SAB 24 DIO 4/4/2	27 50 92 1
Digital input/output module with four inputs and four outputs	IBS SAB 24 DIO 8/4/4	27 19 98 8
Digital output module with eight outputs	IBS SAB 24 DO 8/8	27 50 93 4

Ordering Data (Accessories)

Description	Order Designation	Order No.
2 PG-threaded joints for bus connection	IBS SAB-CG/PG 9	16 62 13 3
Protective caps (5 pcs.)	IBS IP PROT IO	27 59 91 9
Markers	SS ZB WH (white) SS ZB YE (yellow)	50 31 17 1 50 31 65 0
Replacement connector set for the bus connection	IBS SAB PLSET	27 51 50 6
Freely configurable M12 connectors for SAB, straight version		
4-pos., with plastic knurl, PG7	SACC-M12MS-4CON-PG7	16 81 08 8
4-pos., with metal knurl, PG7	SACC-M12MS-4CON-PG7-M	16 62 52 8
5-pos., with plastic knurl, PG7	SACC-M12MS-5CON-PG7	16 62 25 6
5-pos., with metal knurl, PG7	SACC-M12MS-5CON-PG7-M	16 63 11 6
5-pos., with metal knurl, PG9	SACC-M12MS-5CON-PG9-M	16 81 46 0

Description	Order Designation	Order No.
Freely configurable M12 connectors for SAB, angled version		
4-pos., with plastic knurl, PG7	SACC-M12MR-4CON-PG7	16 81 09 1
4-pos., with metal knurl, PG7	SACC-M12MR-4CON-PG7-M	16 81 10 1
5-pos., with plastic knurl, PG7	SACC-M12MR-5CON-PG7	16 62 26 9
5-pos., with metal knurl, PG7	SACC-M12MR-5CON-PG7-M	16 63 12 9
5-pos., with metal knurl, PG9	SACC-M12MR-5CON-PG9-M	16 81 47 3
Double male connector, plastic, straight for two cables, PG11		
5-pos., with plastic knurl	SACC-M12MS-5CON-PG11-DUO	16 62 28 5
5-pos., with metal knurl	SACC-M12MS-5CON-PG11-DUO-M	16 62 74 8
Assembled sensor/actuator cable, M12, 3-pos., straight male connector on straight female connector		
Cable length 0.3 m (0.984 ft.)	SAC-3P-M12MS/0,3-PUR/M12FS	16 81 50 9
Cable length 0.6 m (1.969 ft.)	SAC-3P-M12MS/0,6-PUR/M12FS	16 81 51 2
Cable length 1.5 m (4.921 ft.)	SAC-3P-M12MS/1,5-PUR/M12FS	16 81 52 5
Cable length 3.0 m (9.843 ft.)	SAC-3P-M12MS/3,0-PUR/M12FS	16 81 53 8
Assembled sensor/actuator cable, M12, 3-pos., straight male connector on angled female connector		
Cable length 0.3 m (0.984 ft.)	SAC-3P-M12MS/0,3-PUR/M12FR	16 81 54 1
Cable length 0.6 m (1.969 ft.)	SAC-3P-M12MS/0,6-PUR/M12FR	16 81 55 4
Cable length 1.5 m (4.921 ft.)	SAC-3P-M12MS/1,5-PUR/M12FR	16 81 56 7
Cable length 3.0 m (9.843 ft.)	SAC-3P-M12MS/3,0-PUR/M12FR	16 81 57 0
Assembled sensor/actuator cable, M12, 4-pos., straight male connector on straight female connector		
Cable length 0.3 m (0.984 ft.)	SAC-4P-M12MS/0,3-PUR/M12FS	16 68 35 7
Cable length 0.6 m (1.969 ft.)	SAC-4P-M12MS/0,6-PUR/M12FS	16 68 36 0
Cable length 1.5 m (4.921 ft.)	SAC-4P-M12MS/1,5-PUR/M12FS	16 68 37 3
Cable length 3.0 m (9.843 ft.)	SAC-4P-M12MS/3,0-PUR/M12FS	16 68 38 6
Assembled sensor/actuator cable, M12, 4-pos., straight male connector on angled female connector		
Cable length 0.3 m (0.984 ft.)	SAC-4P-M12MS/0,3-PUR/M12FR	16 68 47 0
Cable length 0.6 m (1.969 ft.)	SAC-4P-M12MS/0,6-PUR/M12FR	16 68 48 3
Cable length 1.5 m (4.921 ft.)	SAC-4P-M12MS/1,5-PUR/M12FR	16 68 49 6
Cable length 3.0 m (9.843 ft.)	SAC-4P-M12MS/3,0-PUR/M12FR	16 68 50 6

Description	Order Designation	Order No.
Assembled sensor/actuator cable, M12, 5-pos., straight male connector on straight female connector		
Cable length 0.3 m (0.984 ft.)	SAC-5P-M12MS/0,3-PUR/M12FS	16 81 58 3
Cable length 0.6 m (1.969 ft.)	SAC-5P-M12MS/0,6-PUR/M12FS	16 81 59 6
Cable length 1.5 m (4.921 ft.)	SAC-5P-M12MS/1,5-PUR/M12FS	16 81 60 6
Cable length 3.0 m (9.843 ft.)	SAC-5P-M12MS/3,0-PUR/M12FS	16 81 61 9
Assembled sensor/actuator cable, M12, 5-pos., straight male connector on angled female connector		
Cable length 0.3 m (0.984 ft.)	SAC-5P-M12MS/0,3-PUR/M12FR	16 81 62 2
Cable length 0.6 m (1.969 ft.)	SAC-5P-M12MS/0,6-PUR/M12FR	16 81 63 5
Cable length 1.5 m (4.921 ft.)	SAC-5P-M12MS/1,5-PUR/M12FR	16 81 64 8
Cable length 3.0 m (9.843 ft.)	SAC-5P-M12MS/3,0-PUR/M12FR	16 81 65 1
Assembled actuator cable, straight male connector M12 on valve male connector type A (DIN 43650)		
Cable length 0.3 m (0.984 ft.)	SAC-3P-M12MS/0,3-PUR/A-1L-S	16 69 07 1
Cable length 0.6 m (1.969 ft.)	SAC-3P-M12MS/0,6-PUR/A-1L-S	16 69 08 4
Cable length 1.5 m (4.921 ft.)	SAC-3P-M12MS/1,5-PUR/A-1L-S	16 69 09 7
Cable length 3.0 m (9.843 ft.)	SAC-3P-M12MS/3,0-PUR/A-1L-S	16 69 10 7
Assembled actuator cable, angled male connector M12 on valve male connector type A (DIN 43650)		
Cable length 0.3 m (0.984 ft.)	SAC-3P-M12MR/0,3-PUR/A-1L-S	16 69 27 5
Cable length 0.6 m (1.969 ft.)	SAC-3P-M12MR/0,6-PUR/A-1L-S	16 69 28 8
Cable length 1.5 m (4.921 ft.)	SAC-3P-M12MR/1,5-PUR/A-1L-S	16 69 29 1
Cable length 3.0 m (9.843 ft.)	SAC-3P-M12MR/3,0-PUR/A-1L-S	16 69 30 1

For varying module data, please refer to the corresponding data sheet or the INTERBUS catalog.

Section 8

This section informs you about

– the module overlapping properties of the 500 V version of INTERBUS motor starters

8 500 V Version of the INTERBUS Motor Starter

This description only refers to 500 V motor starters. The mounting and installation of 400 V motor starters is described separately:

– Mounting and installation of the steel sheet motor starter
  DB GB IBS 400 ELR INST, Part No. 90 00 15 9
– Mounting and installation of the high-grade steel motor starter
  DB GB IBS 400 ELR/MLR-F INST, Part No. 90 00 15 7

8.1 Product Description

INTERBUS motor starters are compact control devices for three-phase asynchronous motors. INTERBUS motor starters are designed for distributed application directly in the system. With these motor starters, three-phase asynchronous motors can be switched through INTERBUS.

Types

This module family has electronic load relays with different functions:

– 2-channel motor starter with eight additional digital inputs
– Reversing-load motor starter with four additional digital inputs
– Reversing-load motor starter with soft-starting function and four additional digital inputs
– Pole-changing (dual speed) motor starter with four additional digital inputs
– Reversing-load pole-changing motor starter with four additional digital inputs

Motor starter features:

– Electronic load relay (wear-resistant)
– Integrated motor protection
– Plug-in connection method
– Power networking up to 500 V AC/ 20 A depending on the module type
– Diagnostic and status indicators
– Startup without bus is possible by means of manual operation
– Sensor inputs
– Outputs for auxiliary devices
– Brake output

Positioning	Motor starters are designed for direct application in machines and systems (IP 54 protection).
Mounting	Motor starters can be mounted with M8 screws on mounting surfaces or on aluminum mounting profiles.
Bus connection	The remote bus is connected to the motor starters together with the supply for the module electronics with SAB connector hoods.
I/O connection	M12 connectors

8.2 Safety Notes

The motor starters and connected machines described refer to equipment used in high power industrial plants. During operation, this equipment has dangerous, live, moving or rotating parts. They can therefore cause considerable damage to health or equipment, e.g., due to the unauthorized removal of protective covers or inadequate maintenance.

– Only qualified personnel may work on the device or system.
– When work is being carried out on the device or system, the operation manual and the relevant product documentation must always be kept at hand and referred to.
– Unqualified personnel are prohibited from working on the machines or in their vicinity.

Qualified personnel are people who, because of their education, experience and instruction and their knowledge of relevant standards, regulations, accident prevention and service conditions, have been authorized by those responsible for the safety of the plant to carry out any required operations and who are able to recognize and avoid any possible dangers. (Definitions for skilled workers according to EN 50110-1:1996).

The process notes and circuit details presented in this data sheet should be understood in a general sense and the relevant application should be tested to see if they apply.

Phoenix Contact cannot guarantee the suitability of the procedures described or the circuit suggestions for the relevant application.

The instructions given in the module-specific data sheets must be followed during installation and startup.

Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Correct use

The modules are only to be used as specified in the catalog and the module-specific data sheet.

Phoenix Contact accepts no liability if the device is used for anything other than its designated use.

Dangerous voltage!

Before working on the device or system, disconnect the AC line voltage and ensure that it cannot be reenergized!

If these instructions are not followed, there is a danger of damage to health and danger of a life-threatening injury.

8.3 Installation Example

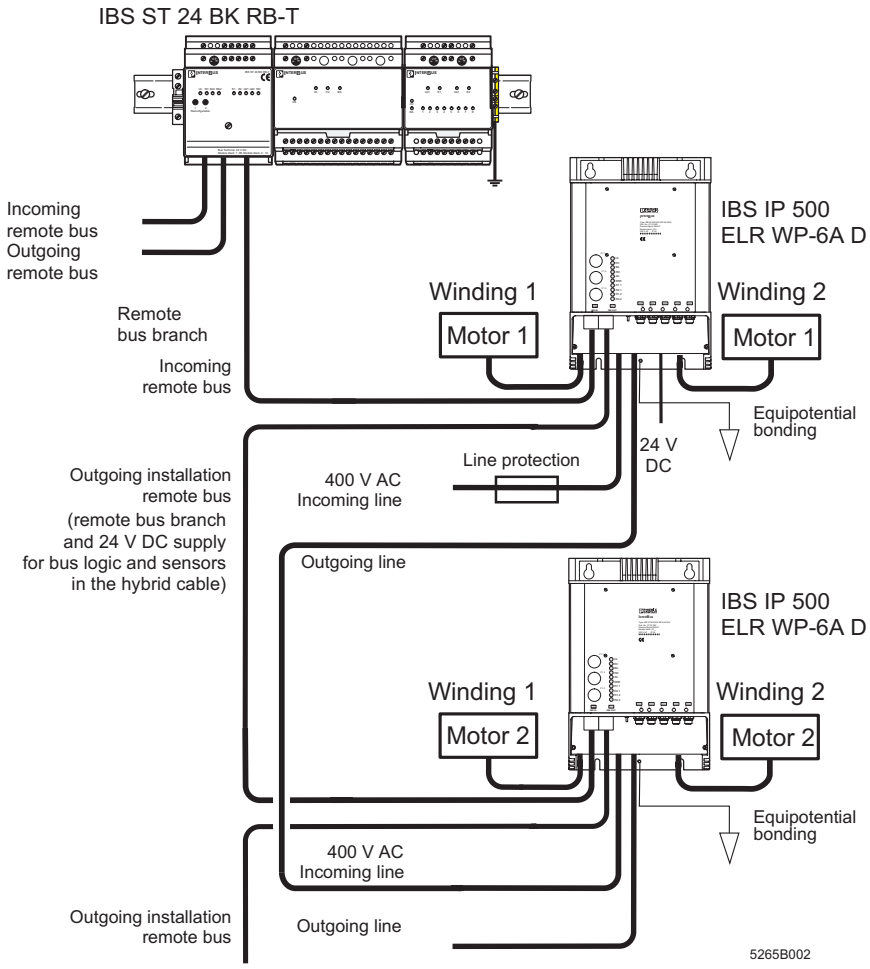


Figure 8-1 Schematic installation example

Select the line protection according to the overall length of the mains cable, i.e., from the distribution to the last module and to the conductor cross-section used. Please take into account the loop impedance to the safety device and the upstream fuse!
(See also: DIN VDE 0100 Part 430 and DIN VDE 0100 Insert 5.)

8.4 Structure of a Motor Starter

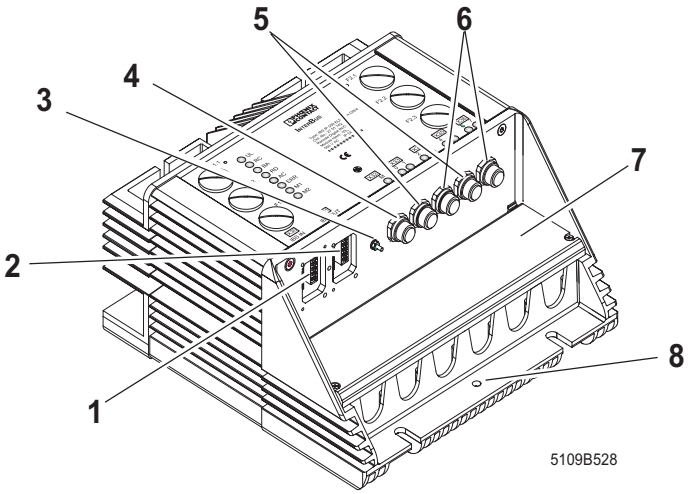


Figure 8-2 Example structure of a motor starter

1 Incoming remote bus
2 Outgoing remote bus
3 Error acknowledgment button
4 Emergency (manual) socket
5 Sensor connections
6 Sensor/actuator connections
7 Terminal connection compartment
8 Equipotential bonding connection

8.5 Diagnostic and Status Indicators

The diagnostic and status indicators allow for quick local error diagnostics.

Diagnostics

The diagnostic indicators (green/red) indicate the type and location of the error. The module is functioning correctly if all of the green LEDs are on.

Status

The status LEDs (yellow) indicate the status of the corresponding input or output.

Motor starters can have the LEDs listed below, but not all of the LEDs are on every module. Depending on the module type, additional LEDs can also indicate the status of the module.

For additional information about a certain module please refer to the corresponding data sheet.

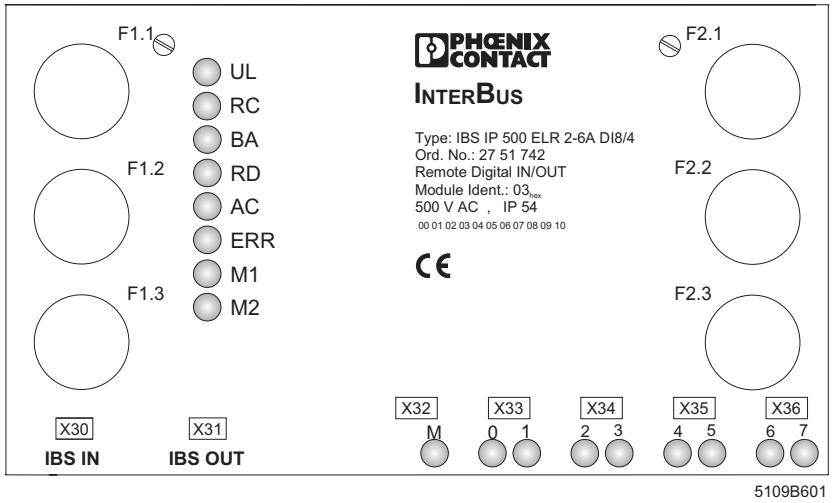


Figure 8-3 LED arrangement (in principle)

Diagnostics

UL	Green LED	Supply voltage of the module electronics
	ON:	Supply voltage in permissible tolerance zone
	OFF:	Supply voltage not present

RC	Green LED	Remote bus connection (remote bus check)
	ON:	Incoming remote bus connection established
	OFF:	Incoming remote bus connection defective
BA	Green LED	Bus active (remote bus active)
	ON:	Data transmission on INTERBUS active
	OFF:	No data transmission
	As of G4	
	Flashing:	Bus active, but no cyclic data transmission
RD	Red LED	Remote bus disabled
	ON:	Outgoing remote bus switched off
	OFF:	Outgoing remote bus switched on
AC	Green LED	Line voltage
	ON:	Line voltage is switched on; all three phases are present
	OFF:	Line voltage is switched off; fuse is defective
ERR	Red LED	Error
	ON:	Error; motor disconnected
	OFF:	No error

Status

Mn	Yellow LED	Status of the motor output
	ON:	Motor n on
	OFF:	Motor n off
Rx	Yellow LED	Status of the motor output
	ON:	Direction of rotation x on
	OFF:	Direction of rotation x off
Rx,y	Yellow LED	Status of the motor output
	ON:	Direction of rotation x on, winding y on
	OFF:	Direction of rotation x off, winding y off
M	Yellow LED	Manual mode
	ON:	Enabled
	OFF:	Disabled
z	Yellow LED	Input z
	ON:	Input z active; signal high
	OFF:	Input z inactive; signal low

8.6 Mounting Motor Starters

Motor starters are mounted directly on mounting angles or mounting plates. The modules can be mounted in a flat (A) or hanging (B) position.

8.6.1 Dimensions of Motor Starter Modules

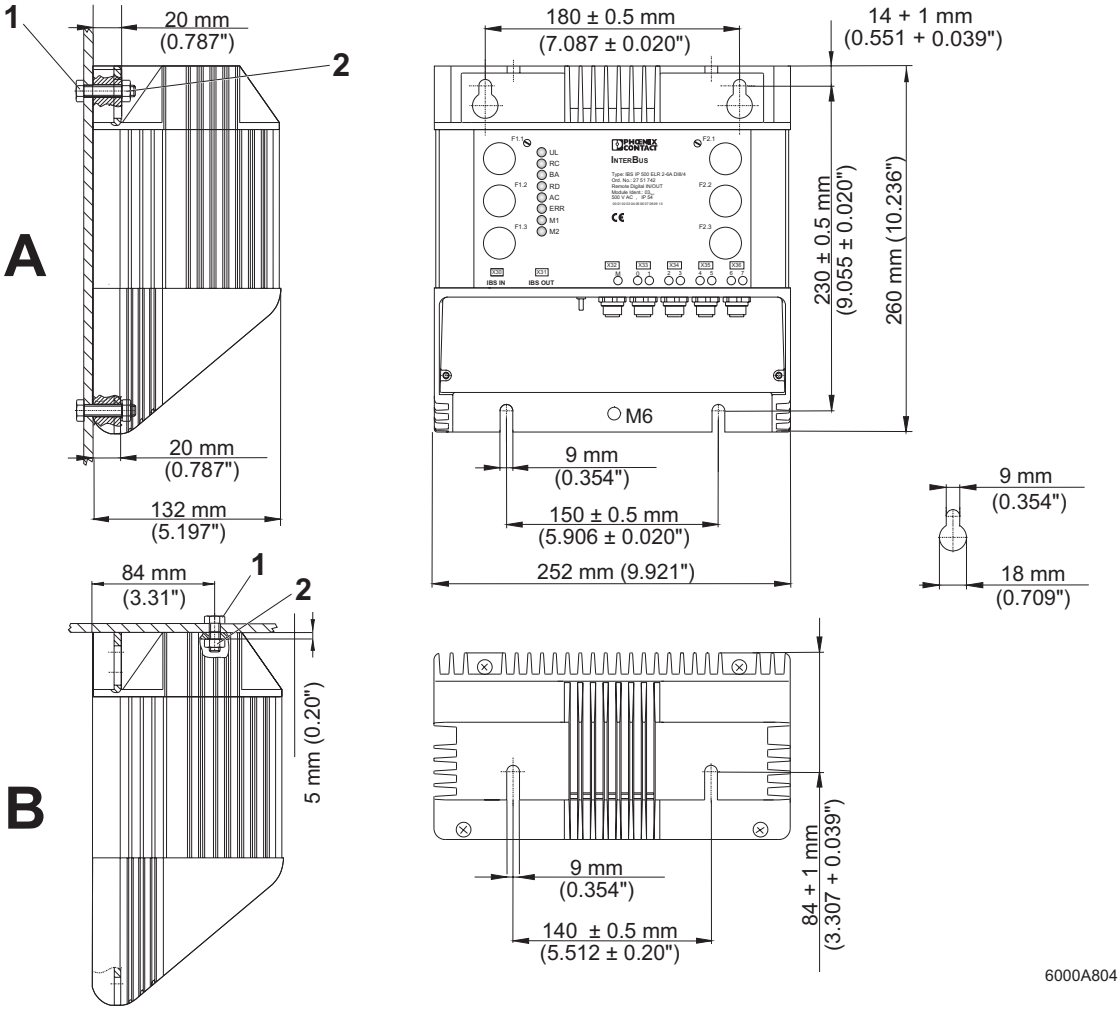


Figure 8-4 Direct installation, housing size 1

1 M8 hexagonal screw

2 M8 hexagonal nut

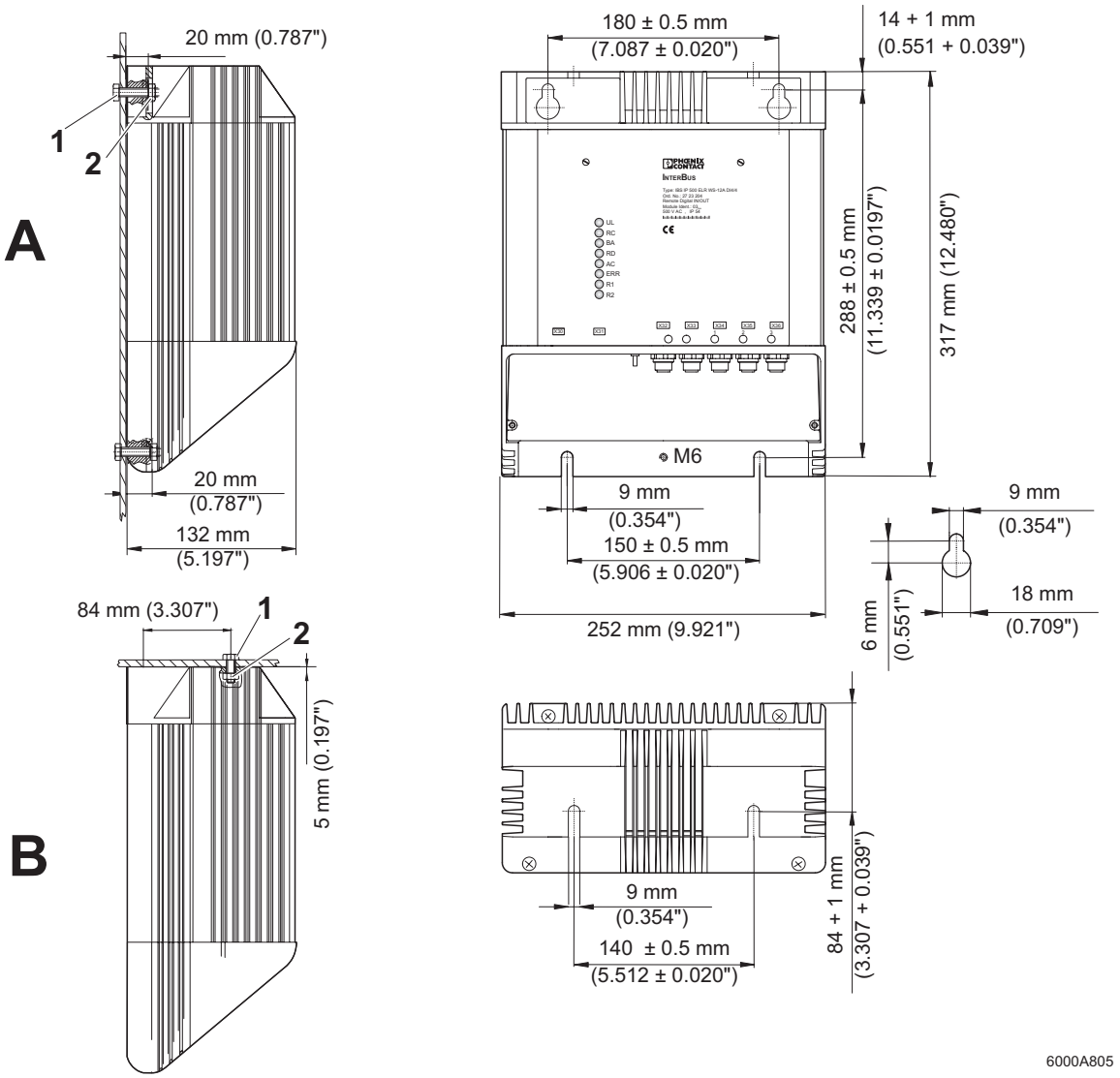


Figure 8-5 Direct installation, housing size 2

1 M8 hexagonal screw

2 M8 hexagonal nut

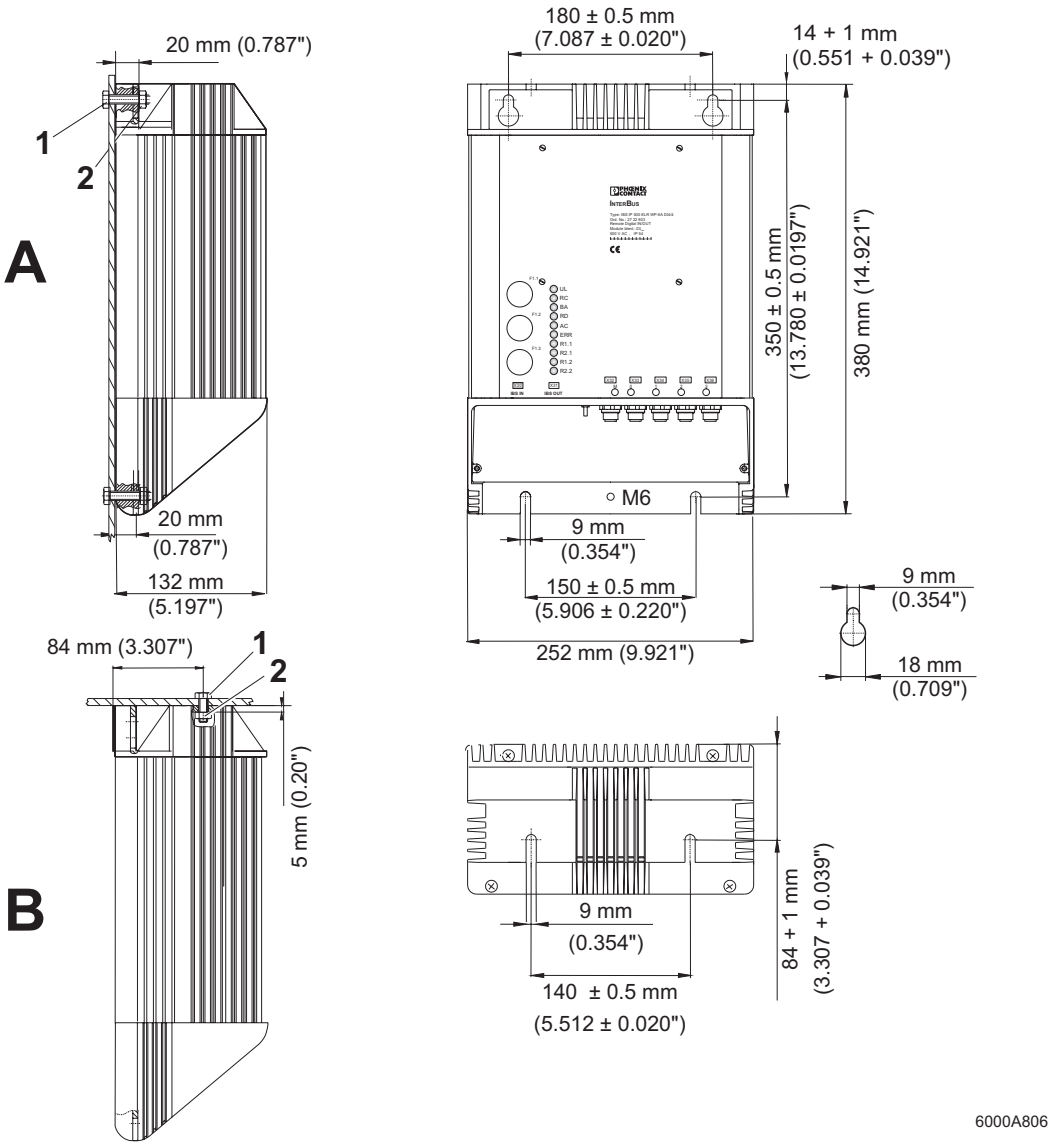


Figure 8-6 Direct installation, housing size 3

1 M8 hexagonal screw

2 M8 hexagonal nut

8.6.2 Mounting Motor Starters

Grounding

If required, connect an equipotential bonding with an M6 screw via the corresponding drill hole in front of the terminal connection compartment.

Flat installation (A)

- Insert four mounting screws with washers into the drill holes of the module and screw the module down.

Hanging installation (B)

- Insert two mounting screws with washers into the prepared drill holes with approximately 2 - 3 turns of the thread.
- Place the motor starter on the mounting angle or mounting plate, align the motor starter drill holes with mounting screws and fasten the motor starter.

8.7 Connecting the Bus Cable to the Motor Starter

Dangerous voltage!

Before working on the motor starter, disconnect the line voltage and ensure that it cannot be reenergized!

8.7.1 Connecting the Remote Bus With SAB Connector Hoods

The connection procedure described below applies to the connection of the bus cable as well as to the connection of the power supply cable.

Motor starters can be used in the installation remote bus or remote bus.

Installation remote bus

In the installation remote bus, the voltage supply for the module electronics can be supplied at the bus terminal module and carried in the hybrid cable (IBS INBC METER; Order No. 27 23 13 6).

Remote bus

In the remote bus, the voltage for the module electronics must be supplied separately. Use the available cable opening in the connector hood for the incoming bus connector or connect the power supply to the corresponding terminal points of the POWER-COMBICON terminal strip.

Please refer to "Wiring MINI-COMBICON connectors" on page 8-18 for the cable plan of the installation remote bus cable and the remote bus cable with separate power supply.

Assembly Steps

- Unscrew the screws and remove the connector hood.

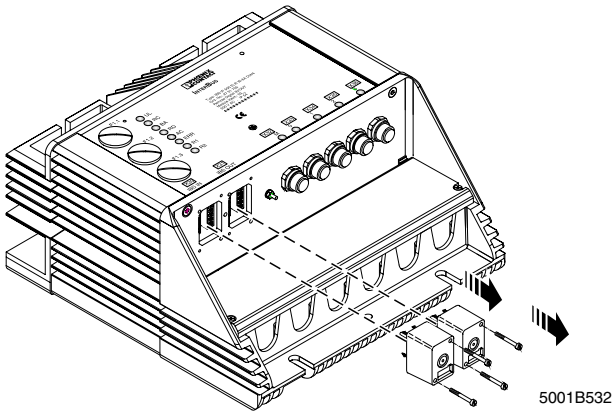


Figure 8-7 Removing the connector hoods of a motor starter

Leading cable through the connector hood

The cables may be fed in through the cable opening at the top or on the side of the connector hood.

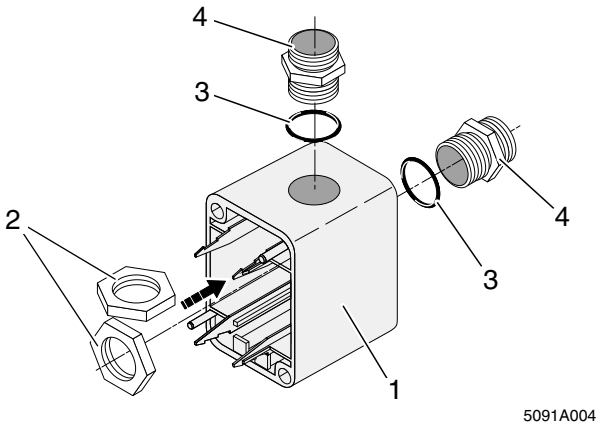


Figure 8-8 Fitting the threaded joints

– Use a screwdriver to break the cable opening out of the connector hood (Figure 8-8).
– Push the O-ring (3) onto the threaded joint (4).

- Place the hexagonal nut (2) of the cable gland (PG) in the recess or in the slot of the connector hood (1).
- Tighten the cable gland by turning the threaded joint with a wrench (17 mm [0.669 in.]).

Leading a cable through the threaded joint and assembling it

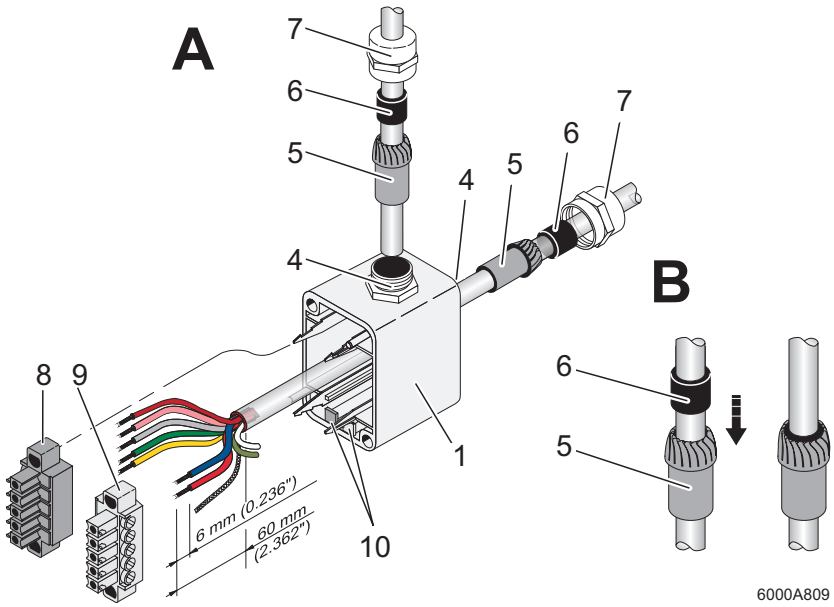


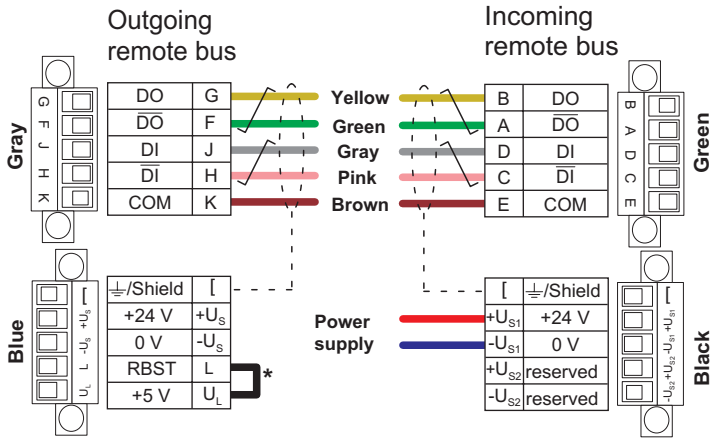
Figure 8-9 Assembling the components of the connector hood

- Push the following parts onto the cable:
  Cap (7), flexible ring (6), strain relief (5), connector hood with threaded joint (1 and 4).
- Strip 60 mm (2.362 in.) off the outer cable sheath.
- Remove the braided shield from the wires and twist as much of it as possible together to form one wire. Crimp a ferrule to the end of this wire.
- Cut off the green/yellow and white wires, as these are not required.
- Strip 6 mm (0.236 in.) off the conductor ends and fit ferrules at the ends.
- Wire the MINI-COMBICON connectors according to Figure 8-10 on page 8-18.

Wiring MINI-COMBICON connectors

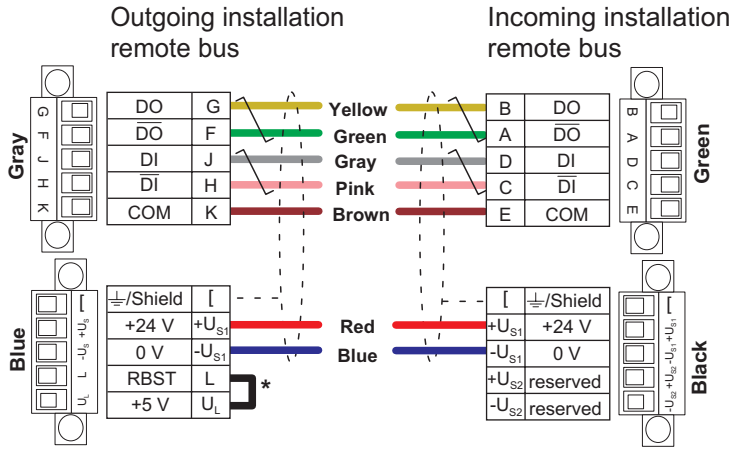
Wire the MINI-COMBICON connectors (8 and 9 in Figure 8-9; A) as shown below.

Remote bus



* This jumper should only be connected if a further module follows.

Installation remote bus



* This jumper should only be connected if a further module follows.

6000A810

Figure 8-10 MINI-COMBICON pin assignment

Mounting strain relief

- Push the flexible ring (6) into the strain relief (5) (Figure 8-9; B).
- Push the strain relief (5) into the threaded joint (4) (Figure 8-9; A).
- Pull the cable back so that the outer cable sheath is still visible from the inside of the connector hood.
- Fasten the cap (7) onto the threaded joint (4) by turning the cap with a wrench (17 mm [0.669 in.]) (Figure 8-9).

Placing the connector hoods

Table 8-1 Color assignment of the MINI-COMBICON connector

INTERBUS IN		INTERBUS OUT	
Green	GN	Gray	GY
Black	BK	Blue	BU

Danger of damaging the module electronics!
Do not mix up the terminals, as this may damage the electronics.

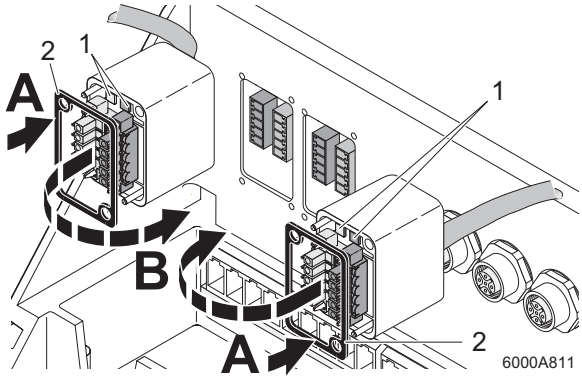


Figure 8-11 Placing the connector hoods

- Snap the MINI-COMBICON connectors onto the locking clips, following the color coding of the coding pins (1 in Figure 8-11).
- Proceed in the same way for cabling the second connector hood.
- Put the gaskets (2 in Figure 8-11) onto the connector hood (A). Place the connector hoods onto the module (B) according to the color codings of the MINI-COMBICON connectors (1 in Figure 8-11).
- Fasten the connector hoods with the supplied screws.

8.7.2 Connecting the Power Periphery

Dangerous voltage!

Before working on the device or system, disconnect the AC line voltage and ensure that it cannot be reenergized!

If these instructions are not followed, there is a danger of damage to health and danger of a life-threatening injury.

The power periphery is connected with POWER-COMBICON. The female connectors are located under a cover in the terminal connection compartment of the module.

The POWER-COMBICON pin assignment can be found in the corresponding data sheets.

The power and bus connectors are not part of the scope of supply (see "Ordering Data (Accessories)" on page 8-30).

Assembling POWER-COMBICON

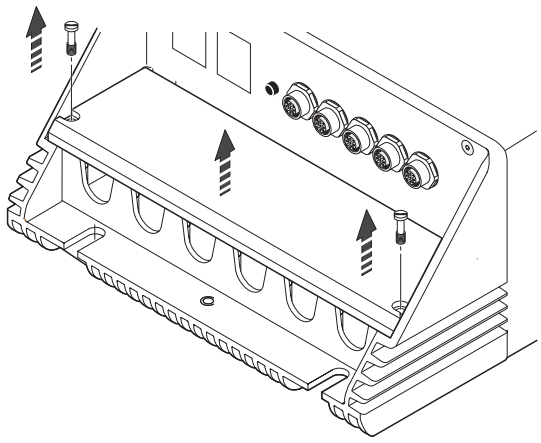


Figure 8-12 Removing the terminal strip cover

- Loosen the two screws of the terminal strip cover and remove the cover.

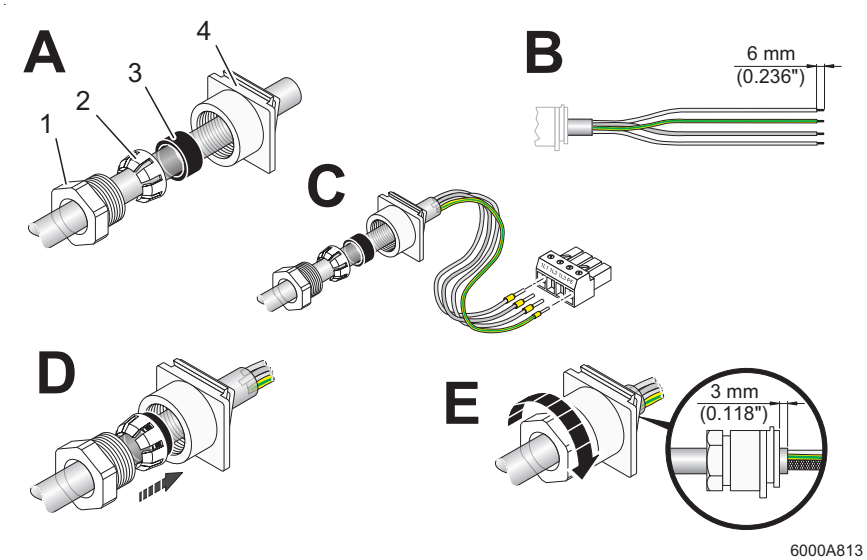


Figure 8-13 Assembling POWER-COMBICON

- Push the cable through the cap nut (1), compression ring (2), grommet (3) and basic unit (4) of the PG-threaded joints (Figure 8-13; A).
- Strip the cable sheath off as required and strip 6 mm (0.236 in) off the wires (Figure 8-13; B).
- Crimp ferrules to the wire ends and wire the POWER-COMBICON connector according to the data sheet (Figure 8-13; C).
- Push the compression ring (2) onto the grommet (3) and, thereafter, both parts into the cable gland (Figure 8-13; D).
- Push these three parts to within approximately 3 mm (0.118 in.) of the insulation. Tighten the PG-threaded joint by turning the cap nut (Figure 8-13; E).

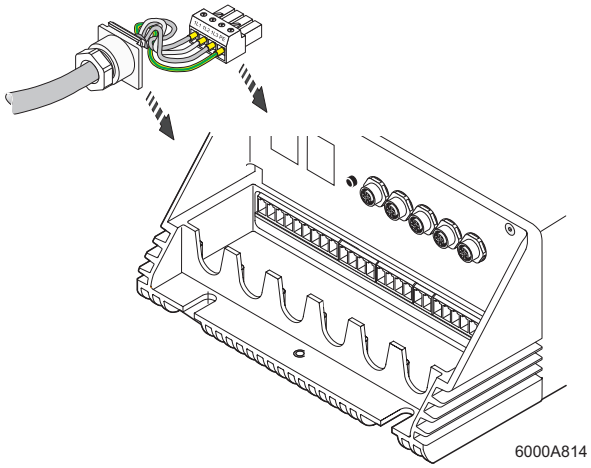


Figure 8-14 Inserting the POWER-COMBICON connector

- Plug the connector into the corresponding terminal strip so that the coding tabs match and push the PG-threaded joint into the associated recess. Insert filler plugs into the unused recesses.

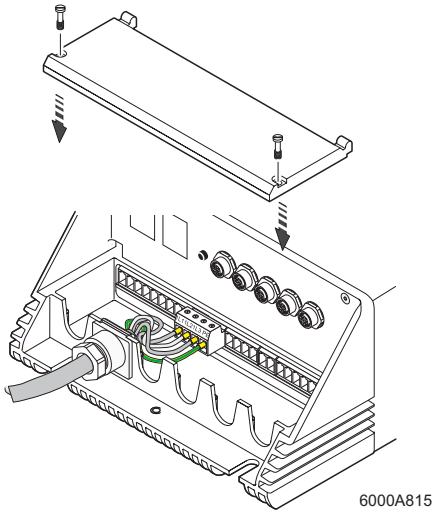


Figure 8-15 Mounting the terminal strip cover

- Mount the terminal strip cover and fasten the screws.

8.8 Parameterizing the Motor Current (Motor Protection)

You can parameterize the nominal current of the drive to set an overload protection.

– In general, a nominal current range of 0.5 A to 6.4 A can be set. Parameterization exceeding 6.4 A is not permissible. This value represents the motor starter rating up to which optimum motor protection can be ensured.
– For the IBS IP 500 ELR WS-12A DI 4/4 motor starter a nominal current range of 0.7 A to 12 A can be parameterized. Parameterization exceeding 12 A is not permissible. This value represents the motor starter rating up to which optimum motor protection can be ensured.

Proceed as follows:

– Subtract the specified offset of 0.5 A (or 0.7 A for motor starter IBS IP 500 ELR WS-12A DI 4/4) from the nominal current of the motor
Example:
The nominal current of the motor is 4.5 A.
The differential value is calculated as follows: 4.5 A – 0.5 A = 4.0 A

– Encode the remaining value (differential value) in bits.
Look up the resolution of the motor starter in the motor starter data sheet. The resolution of the nominal current can be 100 mA or 200 mA. With a resolution of 100 mA, the differential value is encoded in six bits. With a 200 mA resolution, the differential value is encoded in five bits. You can calculate the bits depending on the resolution or find them in Table 8-2 on page 8-25.

Calculating binary values

– 100 mA resolution: Divide the differential value by 0.1 A.
200 mA resolution: Divide the differential value by 0.2 A.
(e.g., 4.0 A / 0.2 A = 20 = 14_{hex} = 1 01 00_{bin})

Reading binary values from the table

– Read the binary value from the table. If the desired value is not in the table you can calculate it from the values that are indicated. Create the desired differential value from two differential values that are indicated and add up the corresponding binary values.
Example: Desired value 3.6 A
3.6 A is the sum of 3.2 A (1 00 00_{bin}) and 0.4 A (0 00 10_{bin}).
The binary value is: 1 00 00_{bin} + 0 00 10_{bin} =1 00 10_{bin}.

– Enter the bits in the parameterization bits PB5 to PB0 in the INTERBUS output data word.

Table 8-2 Parameterizing the motor current

Parameterization Bits							100 mA Resolution*		200 mA Resolution†	
PB 5	PB 4	PB 3	PB 2	PB 1	PB 0	Hex.	Differential Value	Nominal Current of the Motor	Differential Value	Nominal Current of the Motor
0	0	0	0	0	0	00_{hex}	0.0 A	0.5 A	0.0 A	0.5 A
0	0	0	0	0	1	01_{hex}	0.1 A	0.6 A	0.2 A	0.7 A
0	0	0	0	1	0	02_{hex}	0.2 A	0.7 A	0.4 A	0.9 A
0	0	0	0	1	1	03_{hex}	0.3 A	0.8 A	0.6 A	1.1 A
0	0	0	1	0	0	04_{hex}	0.4 A	0.9 A	0.8 A	1.3 A
0	0	0	1	0	1	05_{hex}	0.5 A	1.0 A	1.0 A	1.5 A
0	0	0	1	1	0	06_{hex}	0.6 A	1.1 A	1.2 A	1.7 A
0	0	0	1	1	1	07_{hex}	0.7 A	1.2 A	1.4 A	1.9 A
0	0	1	0	0	0	08_{hex}	0.8 A	1.3 A	1.6 A	2.1 A
0	0	1	0	0	1	09_{hex}	0.9 A	1.4 A	1.8 A	2.3 A
0	0	1	0	1	1	$0B_{hex}$	1.1 A	1.6 A	2.2 A	2.7 A
0	0	1	1	0	1	$0D_{hex}$	1.3 A	1.8 A	2.6 A	3.1 A
0	0	1	1	1	1	$0E_{hex}$	1.5 A	2.0 A	3.0 A	3.5 A
0	1	0	0	0	0	$0F_{hex}$	1.6 A	2.1 A	3.2 A	3.7 A
–	1	1	0	0	0	18_{hex}	–	–	4.8 A	5.3 A
1	0	0	0	0	0	20_{hex}	3.2 A	3.7 A	–	–
–	1	1	1	0	1	$1D_{hex}$	–	–	5.8 A	6.3 A
1	1	0	0	0	0	30_{hex}	4.8 A	5.3 A	–	–
1	1	1	0	1	1	$3B_{hex}$	5.9 A	6.4 A	–	–
1	0	0	0	0	0	20_{hex}	–	–	6.4 A‡	6.9 A‡
1	0	1	0	0	0	28_{hex}	–	–	8.0 A‡	8.5 A‡
1	1	0	0	0	0	30_{hex}	–	–	9.6 A‡	10.1 A‡
1	1	0	0	1	0	32_{hex}	–	–	10.0 A‡	10.5 A‡
1	1	1	0	0	1	39_{hex}	–	–	11.4 A‡	11.9 A‡

* IBS IP 500 ELR 2-6A DI 8/4, IBS IP 500 ELR W-6A DI 4/4, IBS IP 500 ELR WP-6A DI 4/4, IBS IP 500 ELR P-6A DI 4/4

† IBS IP 500 ELR WP-6A DI 4/4, IBS IP 500 ELR P-6A DI 4/4 and IBS IP 500 ELR WS DI 4/4

‡ Is only valid for IBS IP 500 ELR WS DI 4/4

8.9 Motor Behavior in the Event of an Error

Shutdown Behavior in the Case of Errors

The motor is shut down whenever an error occurs. A status message does not cause the motor to shut down.

Restart Behavior After an Error

To restart the motor after it has been shut down due to an error, the error acknowledgment bit must first be set in the INTERBUS output data word (bit 6). Again, an overload error can only be acknowledged after a recovery time of at least one minute.

If the module accepts the reset command, the diagnostic code will be reset. All error flags will be cleared. The overcurrent counter will not be reset. Depending on the shutdown condition, it is reset after a preset period without motor current (approximately 2 to 3 minutes). After resetting the error, the user must reset the error acknowledgment bit (bit 6) in the output data word. Pressing the error acknowledgment button on the module also resets the error. Again, an overload error can only be acknowledged after a recovery time of at least one minute.

The recovery time does not apply to the following errors:

– Phase failure, power failure, blown fuse (error code 9_{hex})
– Sensor supply not present (error code C_{hex})
– Solid-state switch cannot be controlled (error code D_{hex})
– Motor starter not plugged in or motor temperature exceeded (error code E_{hex})

These errors can be reset after 300 ms. Exception: When the emergency mode has been activated, every error can be acknowledged immediately.

8.10 Common Technical Data

The technical data does not claim to be complete. Phoenix Contact reserves the right to make any technical changes that serve the purpose of technical progress.

Ambient Conditions	
Regulations	VDE 0160, 05/88
Ambient temperature	Operation: -20°C to +55°C (-4°F to +131°F), no condensation Storage/transport: -25°C to +75°C (-13°F to +167°F)
Humidity	(no information)
Air pressure	Operation: 80 kPa to 106 kPa (up to 2000 m [6562 ft.] above sea level) Storage/transport: 66 to 106 kPa (up to 3500 m [11483 ft.] above sea level)
Degree of protection	IP 54, IEC 60529 (all mounting directions)
Class of protection	1
Air and creepance distances	VDE 0110-1, 01/89; VDE 0160, 05/88
Housing material	Aluminum
Vibration test	2g, (IEC 60068-2-6) (Amplitude of the acceleration above the limit frequency of 57.53 Hz)
Shock test	(IEC 60068-2-27)

Supply Voltage (U_S)	
Nominal voltage	U_S = 24 V DC
Ripple	U_{PP} = 3.6 V within the permissible voltage range
Permissible voltage range	20 V DC to 30 V DC, ripple included
Current consumption from the installation remote bus	Typ. 0.3 A + sensor current

Sensor Supply	
Minimum voltage	U_S = 2 V DC
Nominal current/sensor	50 mA
Protective circuit	Against inductive reverse voltages, polarity reversal and short circuits

Motor Starters	
Number of outputs, connection method	Module-specific
Operating voltage U_{line} (conductor voltage)	Minimum 200 V AC to maximum 500 V AC, 50 Hz to 60 Hz
Min. output voltage at nominal current	U_{line} minus 3 V
Motor nominal current	0.5 A to 6.4 A, (observe the derating)
No-load motor current	≥ 0.3 A
Phase angle (power factor)	cos φ: 0.3, minimum
Motor nominal power at U_{line} = 400 V AC	3.0 kW (2-pos.), 2.2 kW (4- and 6-pos.)
Protection by fuses in the module (fire protection)	Fuse (6.2 x 32 mm [0.244 in x 1.260 in.]) 10 AT

Motor Protection	
Parameterization	Through INTERBUS
Quick shutdown	35 A after 0.3 seconds
Phase monitoring	Imbalance, phase failure, motor cable disconnection
Trip class	Following Class 10 A of the IEC 60947-4-1990

Brake Outputs	
Number of outputs	Module-specific
Connection voltage	Module-specific
Continuous load current	Module-specific

Thermistor Inputs (PTC According to DIN 44081)	
Number	One input per motor channel
Connection method	POWER-COMBICON

Digital Inputs	
Connection method	M12 connectors
Permissible current consumption per sensor	50 mA, maximum
Input current per channel	Approximately 5 mA at 24 V DC
Permissible input voltage	"1" signal: +13 V DC to 30 V DC "0" signal: -30 V DC to +5 V DC

Digital Outputs	
Connection method	M12 connectors
Output current per channel	0.5 A, maximum
Output voltage at nominal current	U_S minus 2 V DC
Short circuit protection	Electronic

Emergency Mode Function	
Number of inputs	3
Connection method	M12 connectors
Input current per channel	Approximately 5 mA at 24 V DC

Data Interface to INTERBUS	
Cable lengths	Remote bus: maximum 400 m (1312.336 ft.) between two devices; Installation remote bus: 50 m (164.042 ft.), maximum, between two devices; 50 m (164.042 ft.), maximum, between BK module and last device
Error evaluation	Diagnostic and status indicators
Electrical isolation	Module-specific

Ordering Data

Description	Order Designation	Order No.
2-channel motor starter with 8 digital inputs	IBS IP 500 ELR 2-6A DI 8/4	27 51 74 2
Pole-changing (dual speed) motor starter with 4 digital inputs	IBS IP 500 ELR P-6A DI 4/4	27 22 11 1
Reversing-load motor starter with 4 digital inputs	IBS IP 500 ELR W-6A DI 4/4	27 51 75 5
Reversing-load motor starter (pole-changing [dual speed]) with 4 digital inputs	IBS IP 500 ELR WP-6A DI 4/4	27 22 60 3
Reversing-load motor starter with soft-starting function and 4 digital inputs	IBS IP 500 ELR WS-12A DI 4/4	27 23 20 4

Ordering Data (Accessories)

Description	Order Designation	Order No.
Connector set (connectors and PG glands)	IBS ELR PLSET 2-6A	27 24 08 3
	IBS ELR PLSET P-6A	27 24 06 7
	IBS ELR PLSET W-6A	27 24 07 0
	IBS ELR PLSET WP-6A	27 24 05 4
	IBS ELR PLSET WS-12A	27 24 04 1
Front cover (for customer-specific labeling)	IBS ELR COV 2-6A	27 24 24 5
	IBS ELR COV P-6A	27 24 22 9
	IBS ELR COV W-6A	27 24 23 2
	IBS ELR COV WP-6A	27 24 21 6
	IBS ELR COV WS-12A	27 24 20 3

For varying module data, please refer to the corresponding data sheet or the INTERBUS catalog.

A Cable Plans for INTERBUS Cables

The following cable plans contain a short overview of the copper cable assembly for the connection with remote bus devices.

The cable assembly is described in detail in Kapitel 2. Each of the cable plans has a reference to the corresponding page number.

The following remote bus devices can be connected with each other. The page number refers to the page on which you can find the cable plan.

Table A-1 Connecting remote bus devices (copper)

To INTERBUS IN / **From INTERBUS OUT**			ST-BK RT module	ST-BKM	SAB motor starter		CT I/O gateway
			D-SUB female connector, 9-pos.	MINI-COMBICON, 8-pos.	MINI-COMBICON, 5-pos.		MINI-COMBICON, 10-pos.
			RB	RB	RB	IRB	RB
ST-BK RT module	D-SUB male connector, 9-pos.	RB	page A-4	page A-5	page A-6	–	page A-8
ST-BKM	MINI-COMBICON, 8-pos.	RB	page A-9	page A-11	page A-13	–	page A-15
SAB motor starter	MINI-COMBICON, 5-pos.	RB	page A-17	page A-19	page A-21	–	page A-23
		IRB	–	–	–	page A-25	–
CT I/O gateway	MINI-COMBICON, 10-pos.	RB	page A-27	page A-28	page A-29	–	page A-31

– The remote bus devices **cannot** be connected with each other.
RB Remote Bus
IRB Installation Remote Bus
BK Bus Terminal Module

Connecting a remote bus device with fiber optics

In general, remote bus devices with fiber-optic connection cannot be connected with remote bus devices using copper cables. For the conversion from fiber optic to copper (and vice versa) Phoenix Contact offers an interface converter(s).

Please refer to the DB GB IBS SYS FOC ASSEMBLY, Part-No. 94 23 43 9, "Optical Fiber Installation Guidelines" for the cable assembly of fiber optics.

Connecting local bus devices with each other

Local bus devices are connected to the remote bus with a bus terminal module (BK module). Local bus devices can only be combined with each other. They cannot be combined with any other devices. This applies e. g., to Smart Terminals (ST modules).

Connecting ST modules with each other, see Kapitel 4.

Explanation of the Abbreviations

D9	9-pos. D-SUB connector IBS DSUB 9/L (solder connection), Order No. 27 58 47 3 IBS DSUB 9/C (crimp connection), Order No. 27 58 48 6 Assembly see „Assembling D-SUB Connectors“ auf Seite 2-20
MC5	5-pos. MINI-COMBICON Connection and installation for sensor/actuator boxes is described in „Connecting the Remote Bus and the Supply Lines“ auf Seite 7-10 and for motor starters in „Connecting the Remote Bus With SAB Connector Hoods“ auf Seite 8-15.
MC5-I	5-pos. MINI-COMBICON with installation remote bus cable (assembly see MC5)
MC8	8-pos. MINI-COMBICON Assembly and connection to the modules is described under „Connecting a Remote Bus With MINI-COMBICON“ auf Seite 4-21.
MC10	10-pos. MINI-COMBICON Assembly and connection to the modules is described under „Connecting the Remote Bus and the Supply Lines“ auf Seite 7-10.

A 1 Cable Type D9/D9

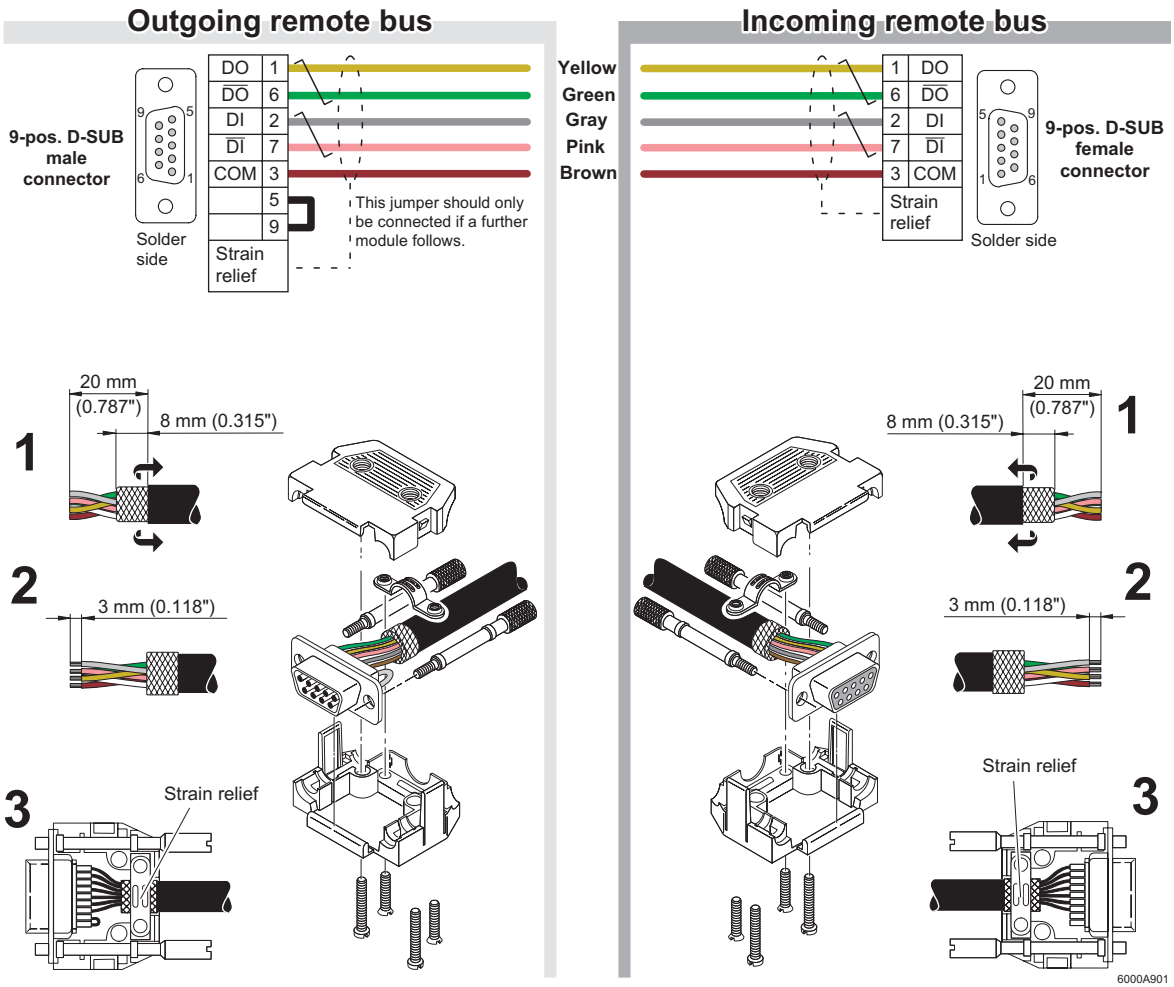


Figure A-1 9-pos. D-SUB/9-pos. D-SUB

For exact instruction see page 2-20

For exact instruction see page 2-20

A 2 Cable Type D9/MC8

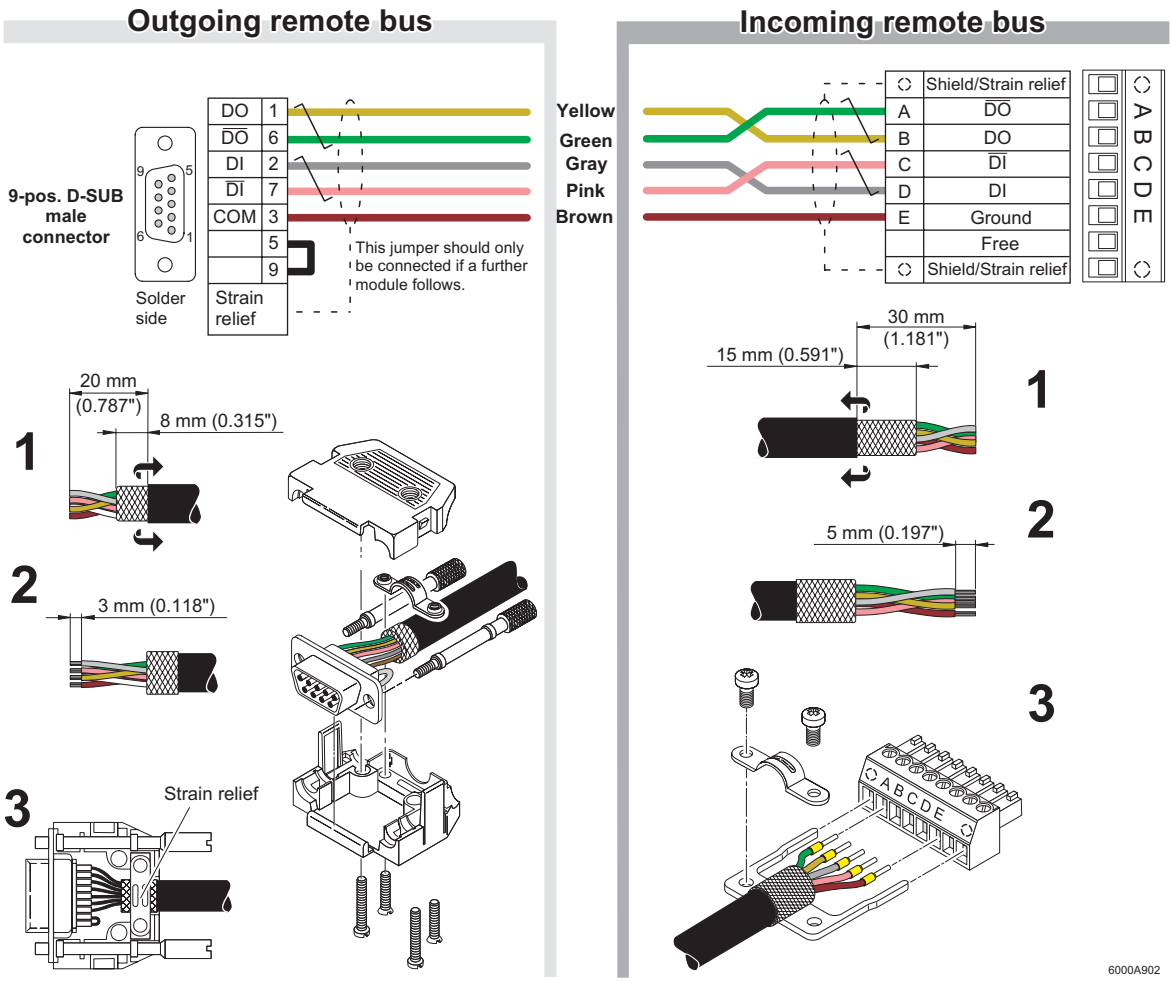


Figure A-2 9-pos. D-SUB/8-pos. MINI-COMBICON

For exact instruction see page 2-20

For exact instruction see page 4-21

A 3 Cable Type D9/MC5

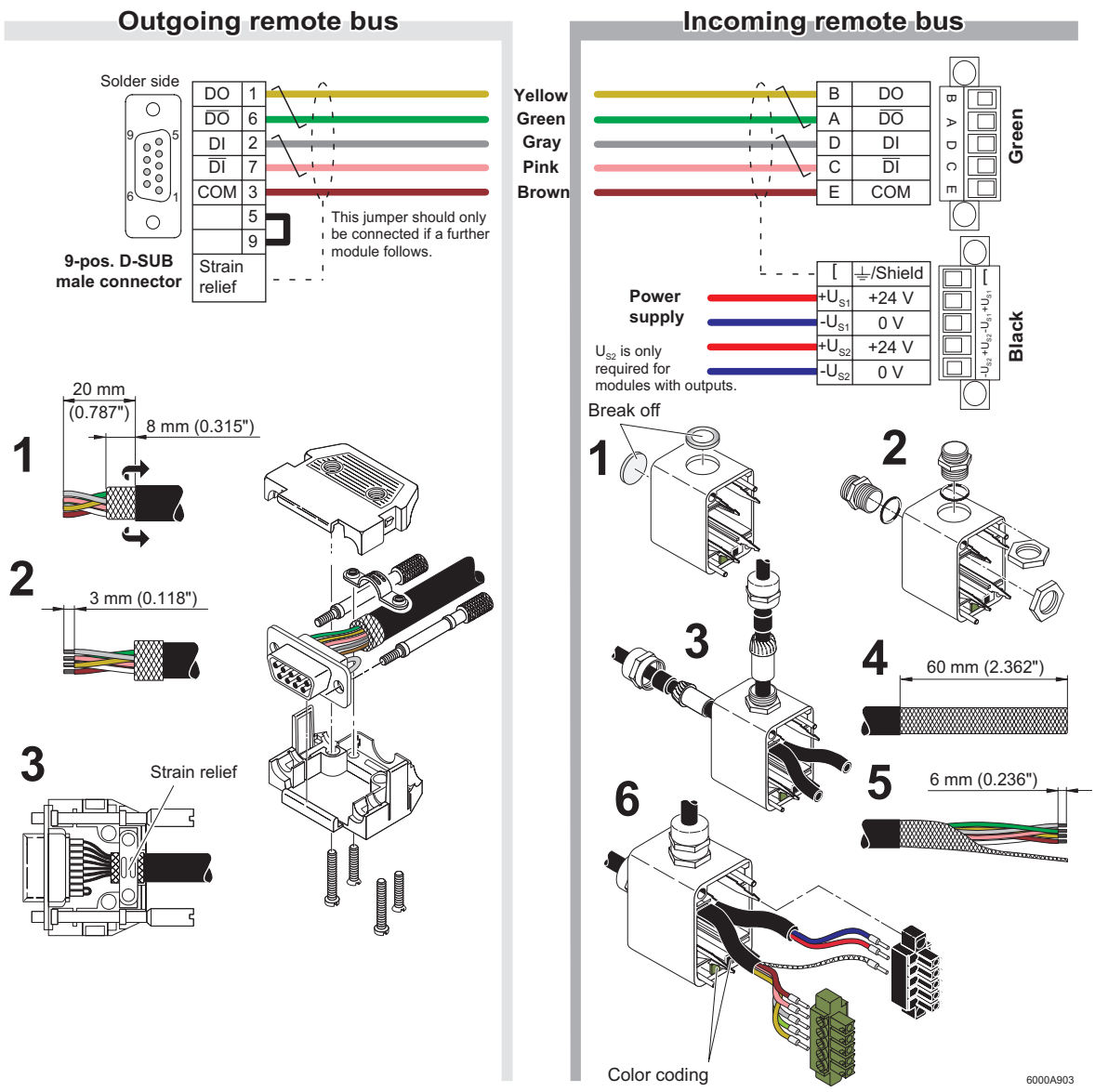


Figure A-3 9-pos. D-SUB/5-pos. MINI-COMBICON

For exact instruction see page 2-20

For exact instruction see page 7-10 and 8-15

A 4 Cable Type D9/MC10

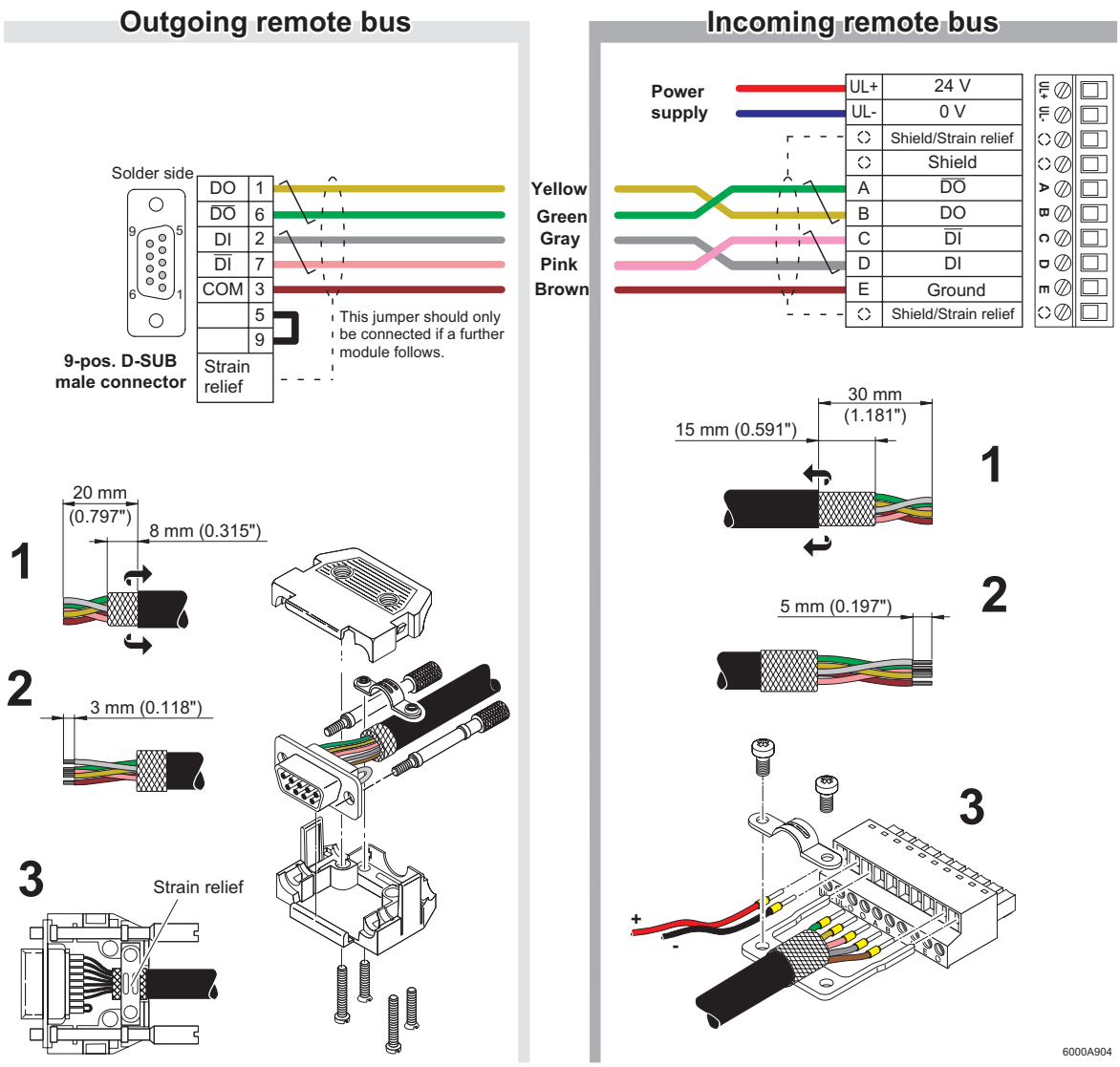


Figure A-4 9-pos. D-SUB/10-pos. MINI-COMBICON

For exact instruction see page 2-20

For exact instruction see page 6-10

A 5 Cable Type MC8/D9

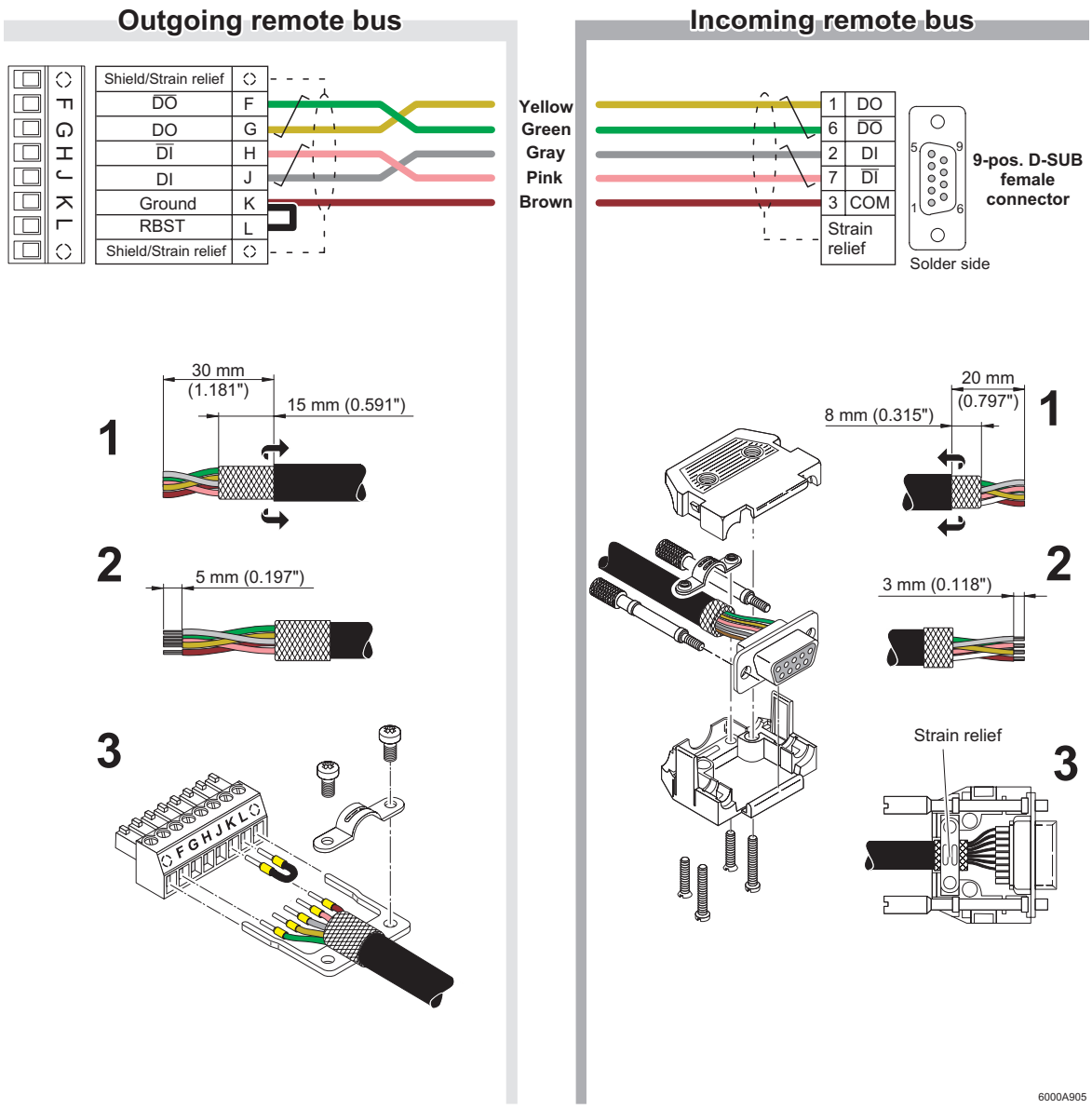


Figure A-5 8-pos. MINI-COMBICON/9-pos.D-SUB

For exact instruction see page 4-21

For exact instruction see page 2-20

A 6 Cable Type MC8/MC8

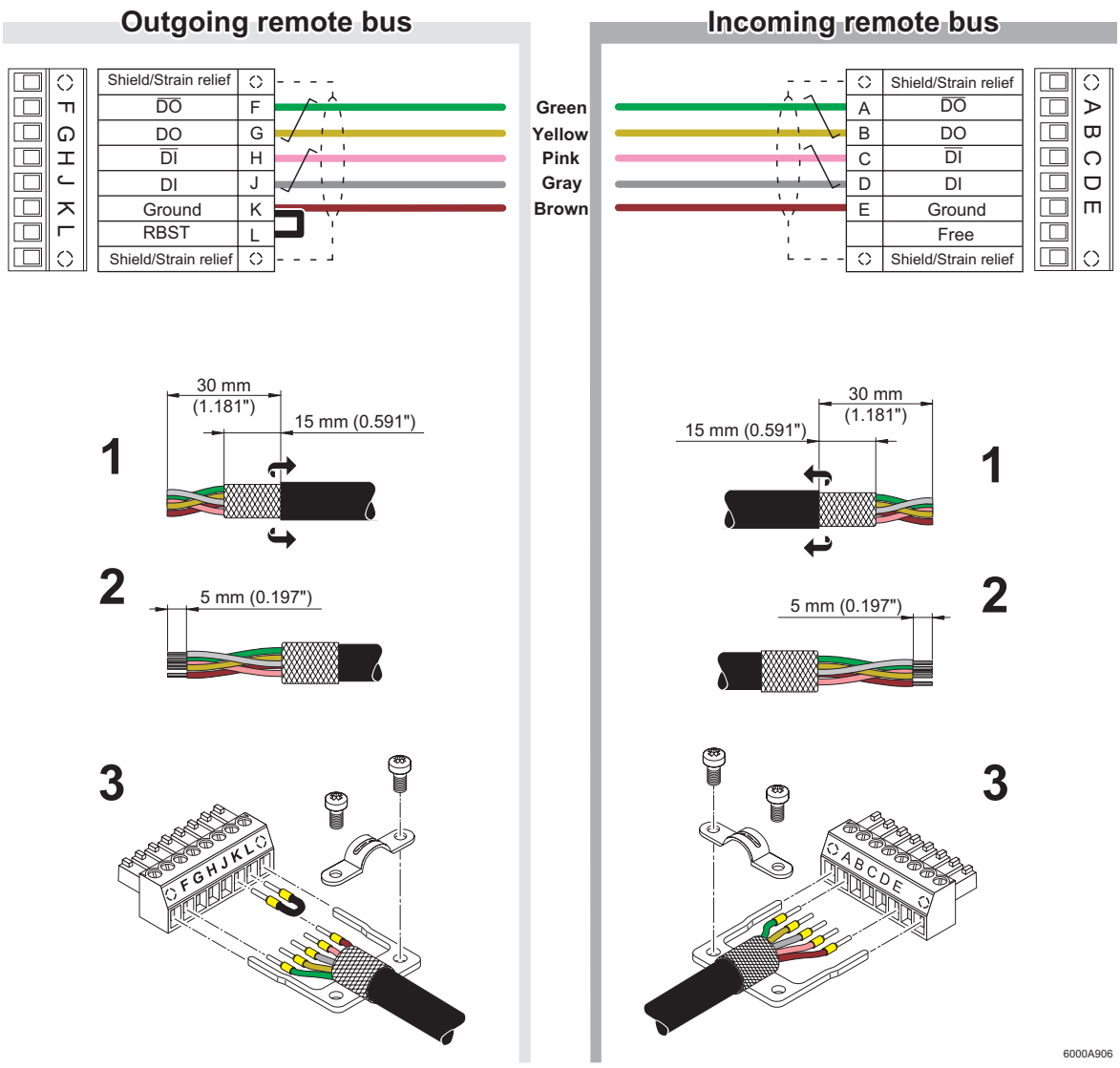


Figure A-6 8-pos. MINI-COMBICON/8-pos. MINI-COMBICON

For exact instruction see page 4-21

For exact instruction see page 4-21

A 7 Cable Type MC8/MC5

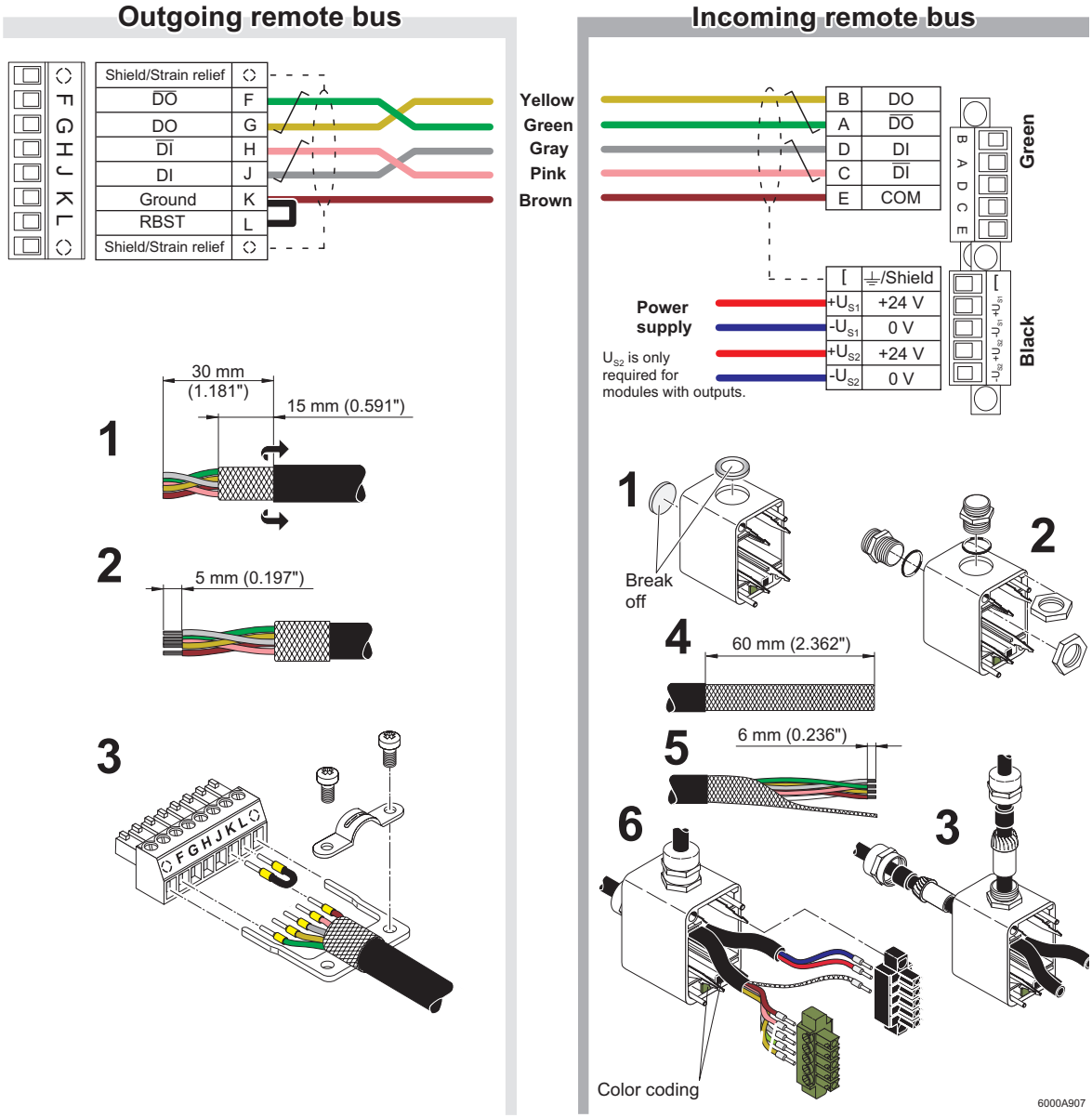


Figure A-7 8-pos. MINI-COMBICON/5-pos. MINI-COMBICON

For exact instruction see page 4-21

For exact instruction see page 7-10 and 8-15

A 8 Cable Type MC8/MC10

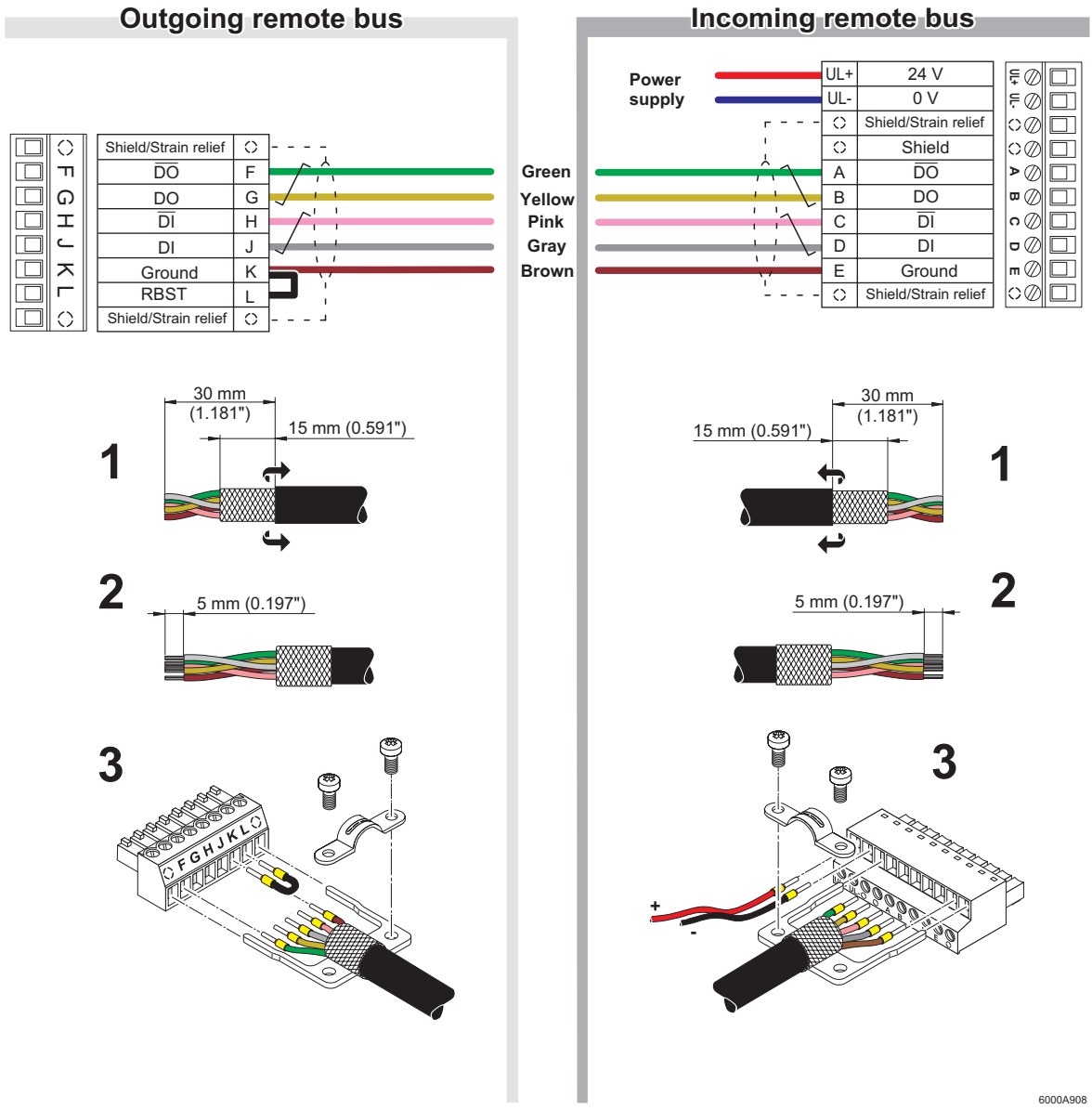


Figure A-8 8-pos. MINI-COMBICON/10-pos. MINI-COMBICON

For exact instruction see page 4-21

For exact instruction see page 6-10

A 9 Cable Type MC5/D9

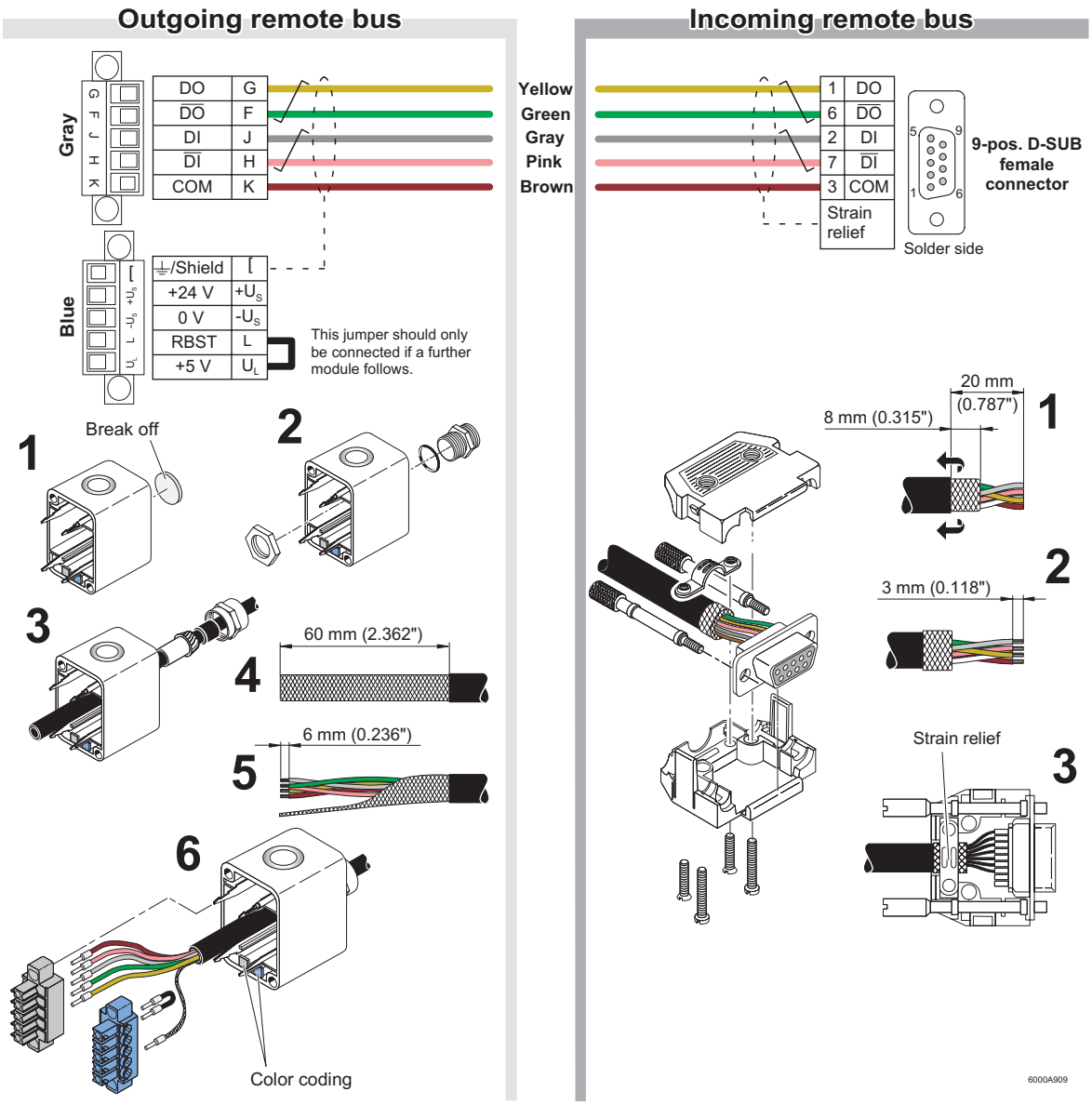


Figure A-9 5-pos. MINI-COMBICON/9-pos.D-SUB

For exact instruction see page 7-10 and 8-15

For exact instruction see page 2-20

A 10 Cable Type MC5/MC8

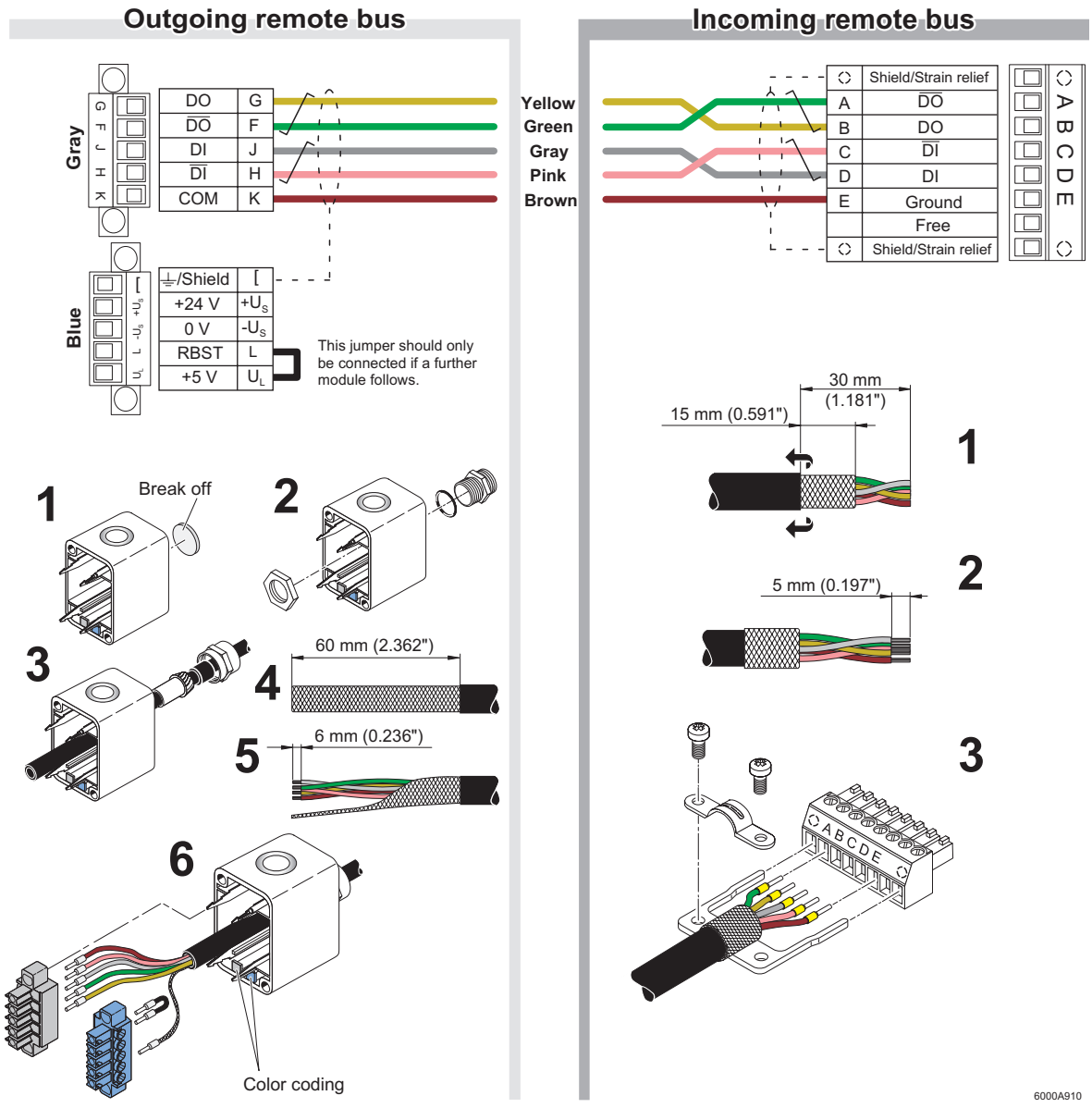


Figure A-10 5-pos. MINI-COMBICON/8-pos. MINI-COMBICON

For exact instruction see page 7-10 and 8-15

For exact instruction see page 4-21

A 11 Cable Type MC5/MC5

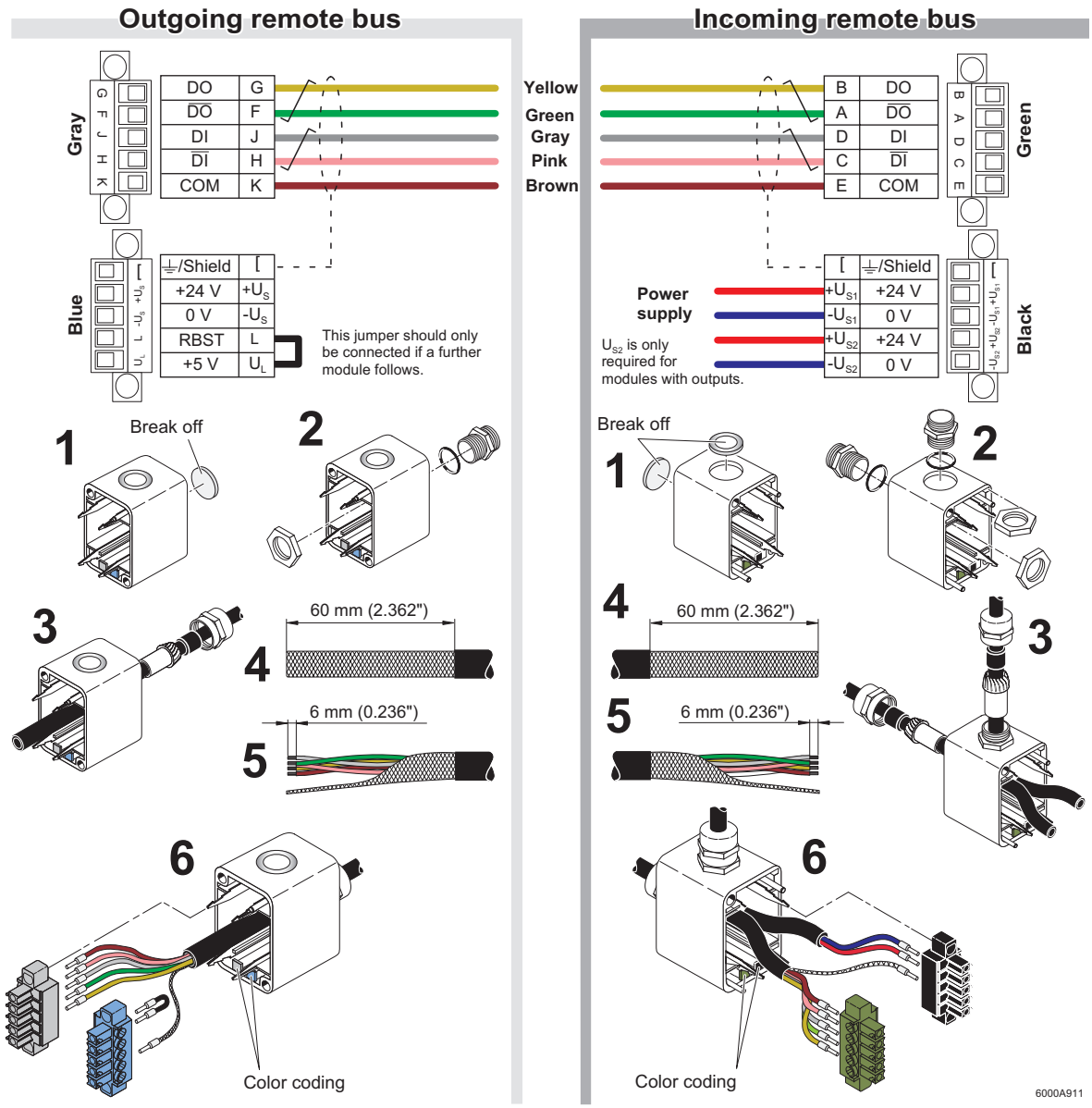


Figure A-11 5-pos. MINI-COMBICON/5-pos. MINI-COMBICON

For exact instruction see page 7-10 and 8-15

For exact instruction see page 7-10 and 8-15

A 12 Cable Type MC5/MC10

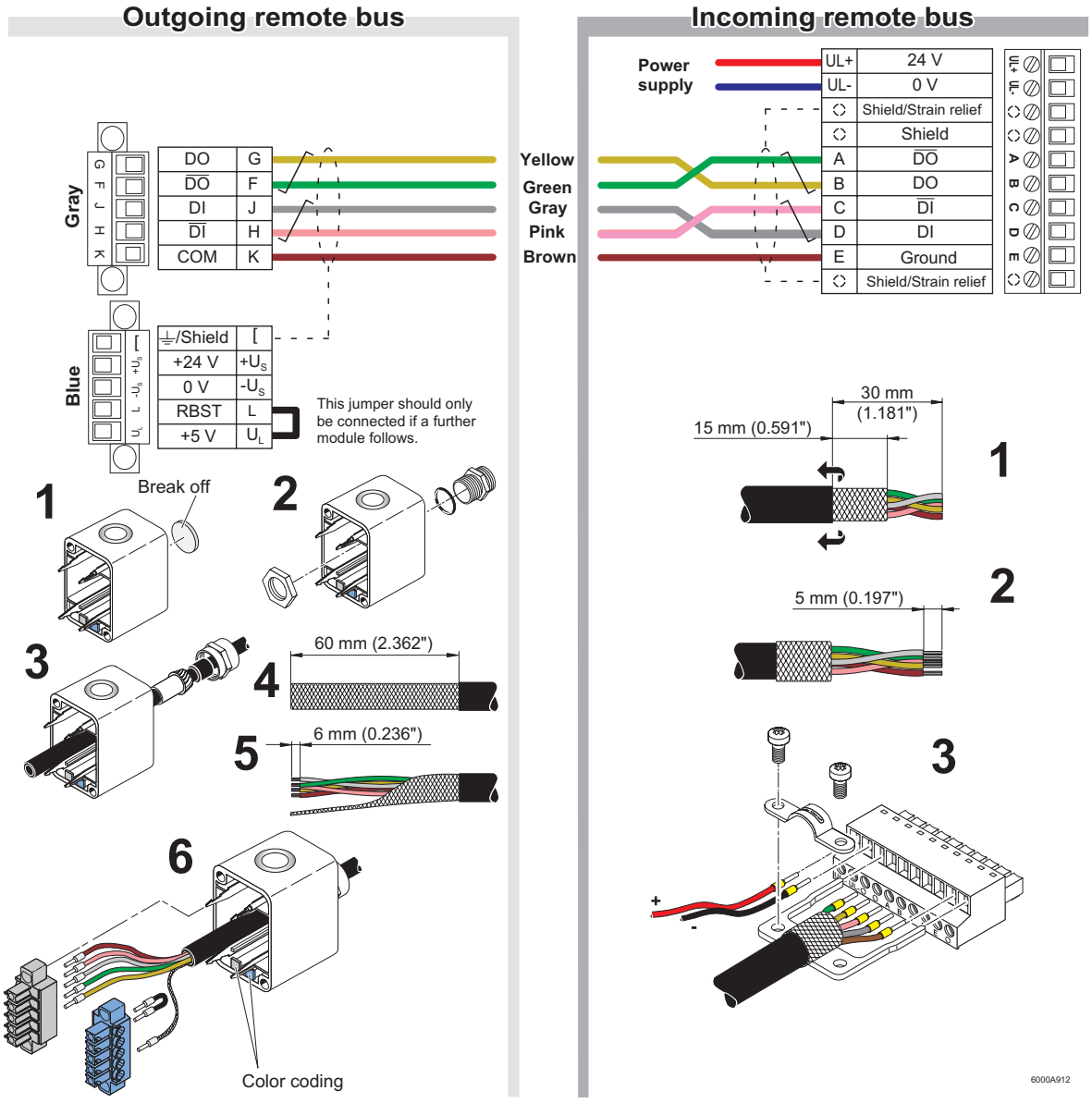


Figure A-12 5-pos. MINI-COMBICON/10-pos. MINI-COMBICON

For exact instruction see page 7-10 and 8-15

For exact instruction see page 6-10

A 13 Cable Type MC5-I/MC5-I

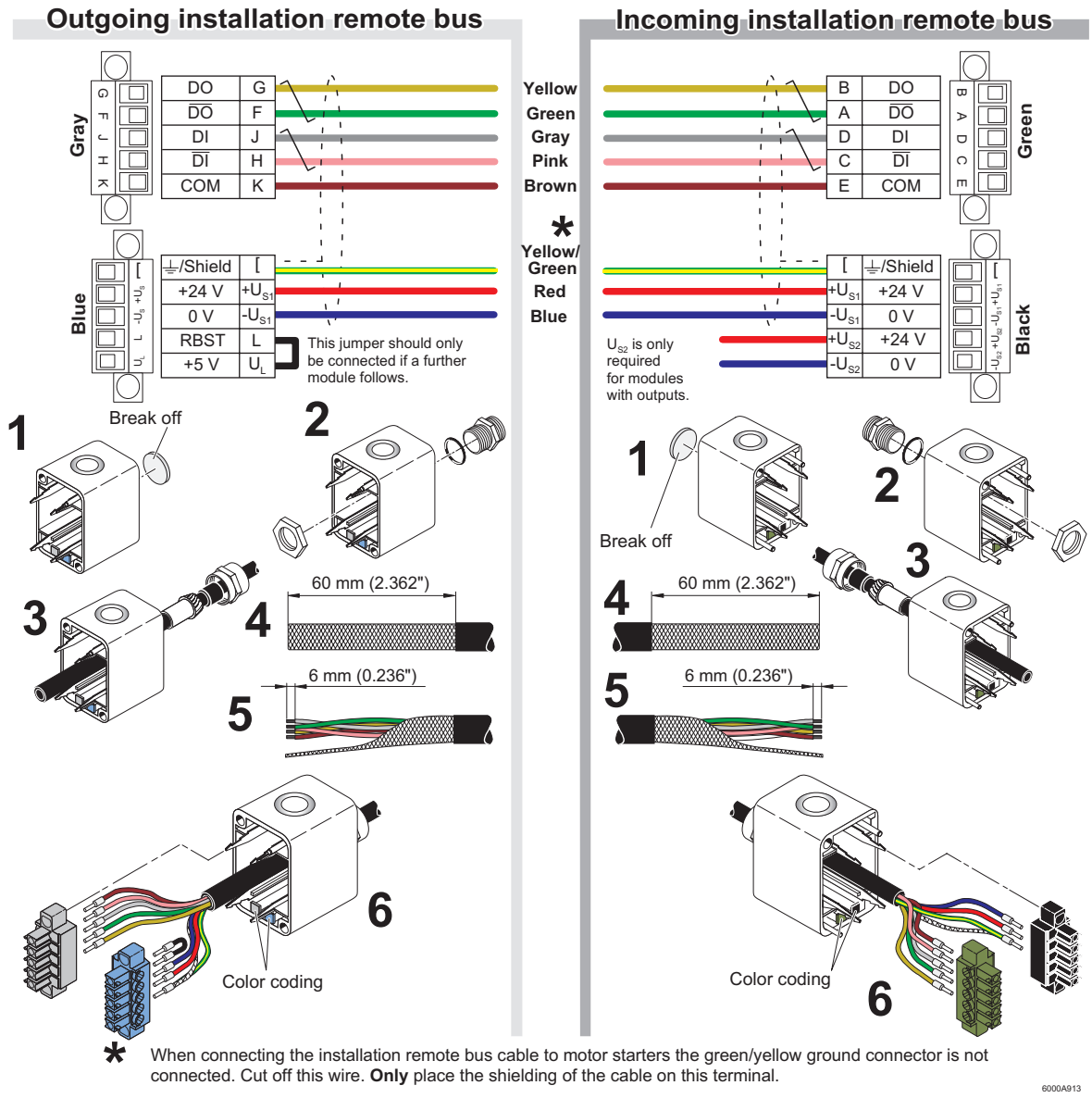


Figure A-13 5-pos. MINI-COMBICON with installation remote bus

For exact instruction see page 7-10 and 8-15

For exact instruction see page 7-10 and 8-15

A 14 Cable Type MC10/D9

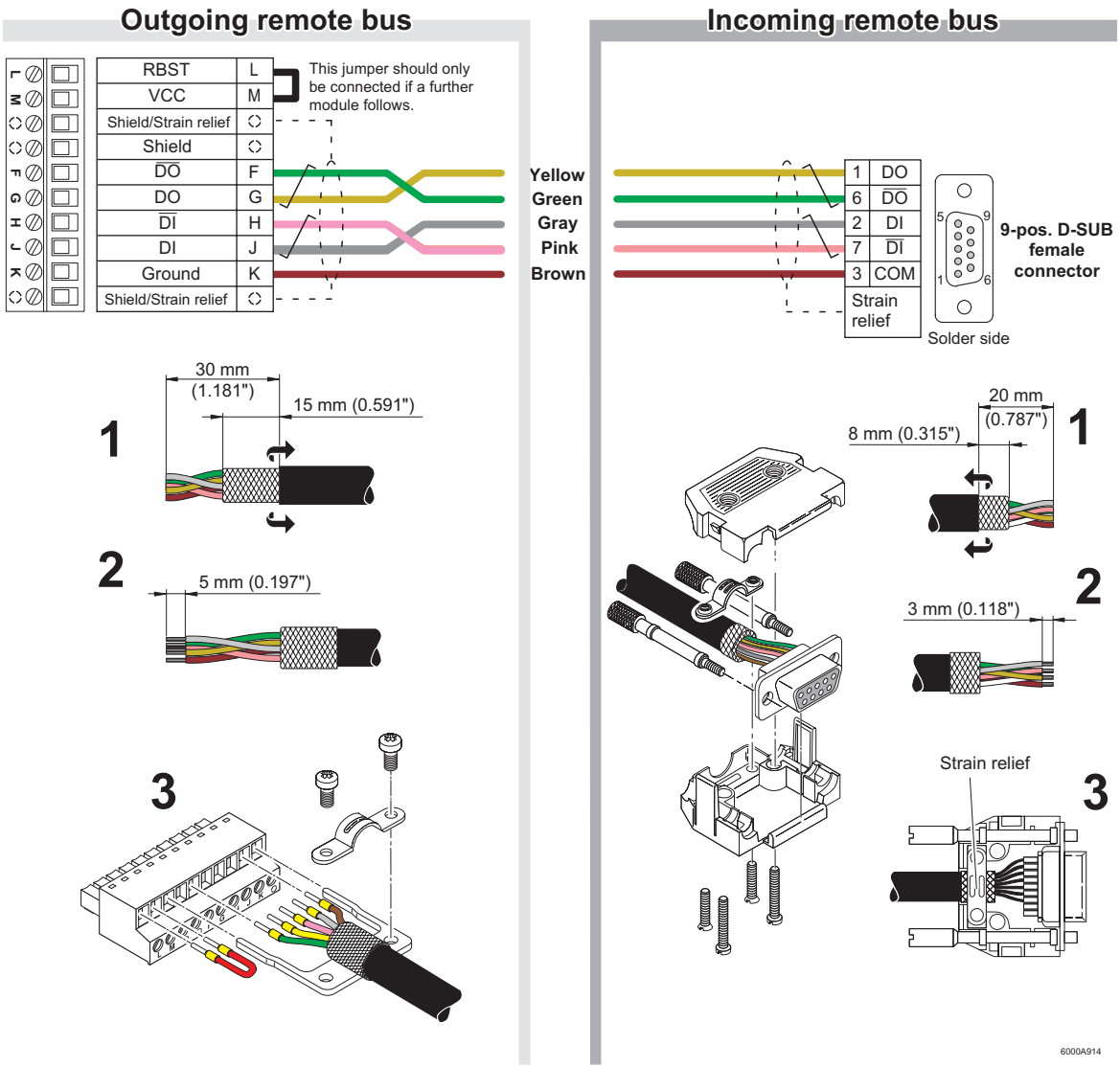


Figure A-14 10-pos. MINI-COMBICON/9-pos.D-SUB

For exact instruction see page 6-10

For exact instruction see page 2-20

A 15 Cable Type MC10/MC8

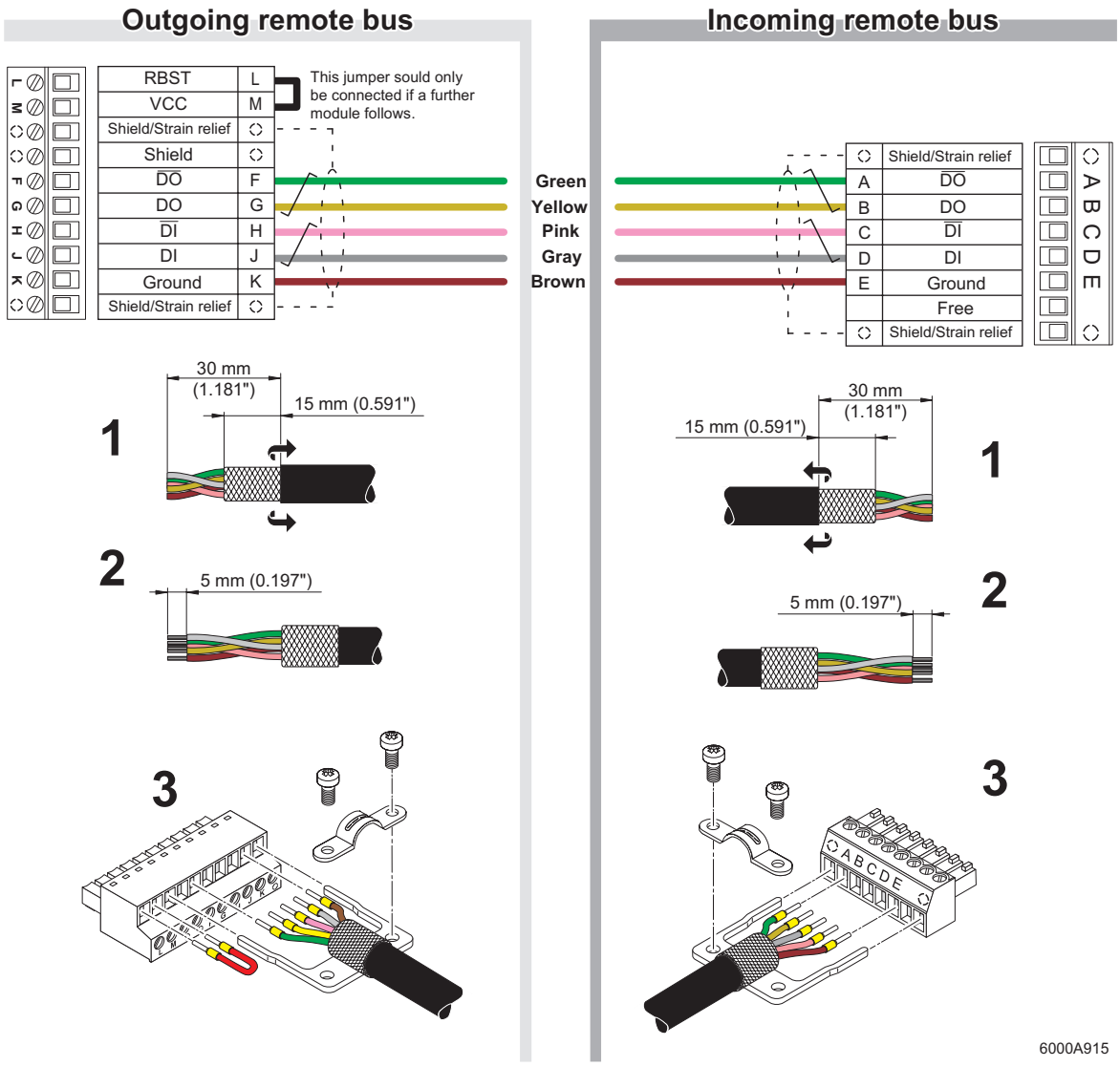


Figure A-15 10-pos. MINI-COMBICON/8-pos. MINI-COMBICON

For exact instruction see page 6-10

For exact instruction see page 4-21

A 16 Cable Type MC10/MC5

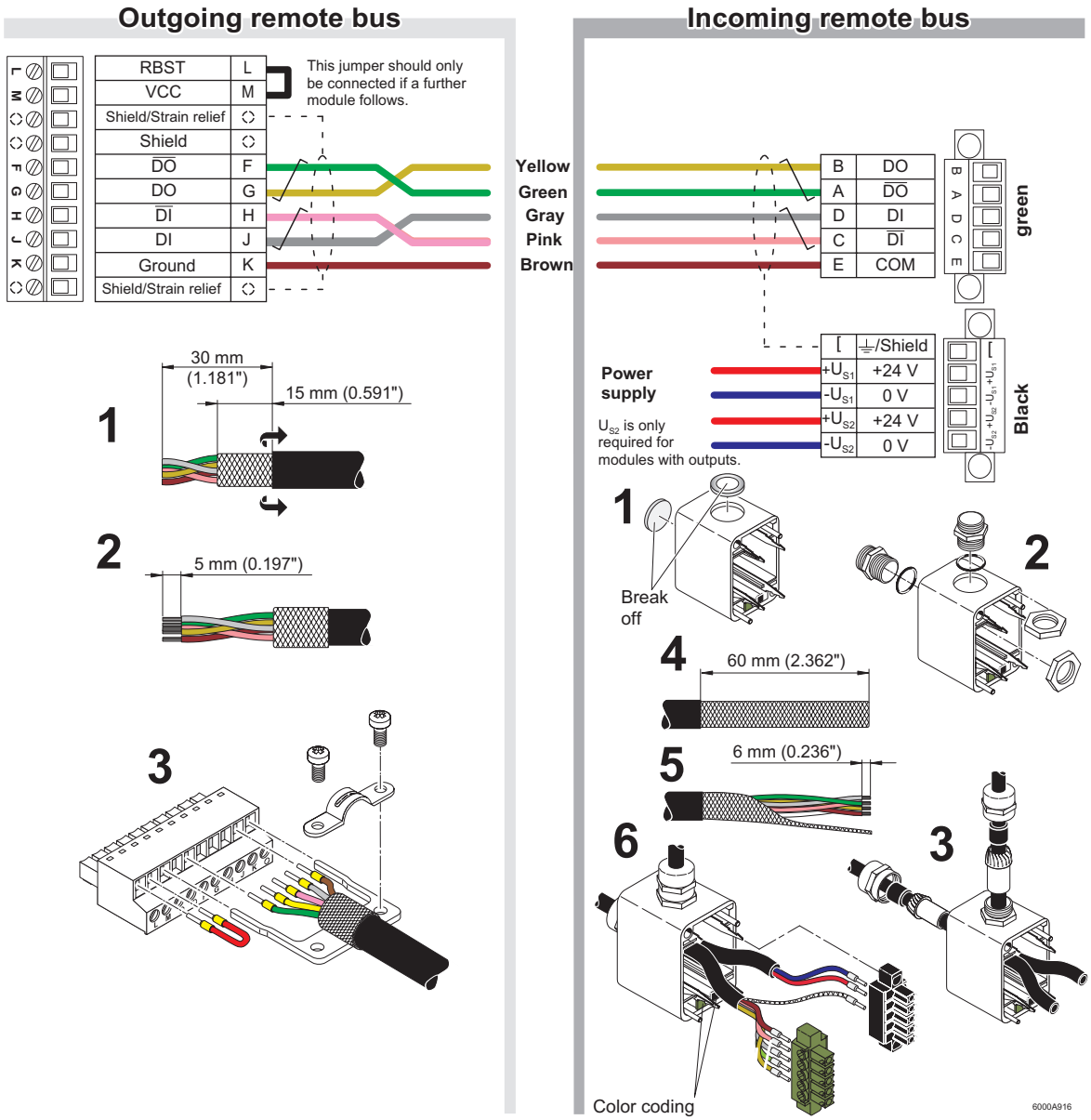


Figure A-16 10-pos. MINI-COMBICON/5-pos. MINI-COMBICON

For exact instruction see page 6-10

For exact instruction see page 7-10 and 8-15

A 17 Cable Type MC10/MC10

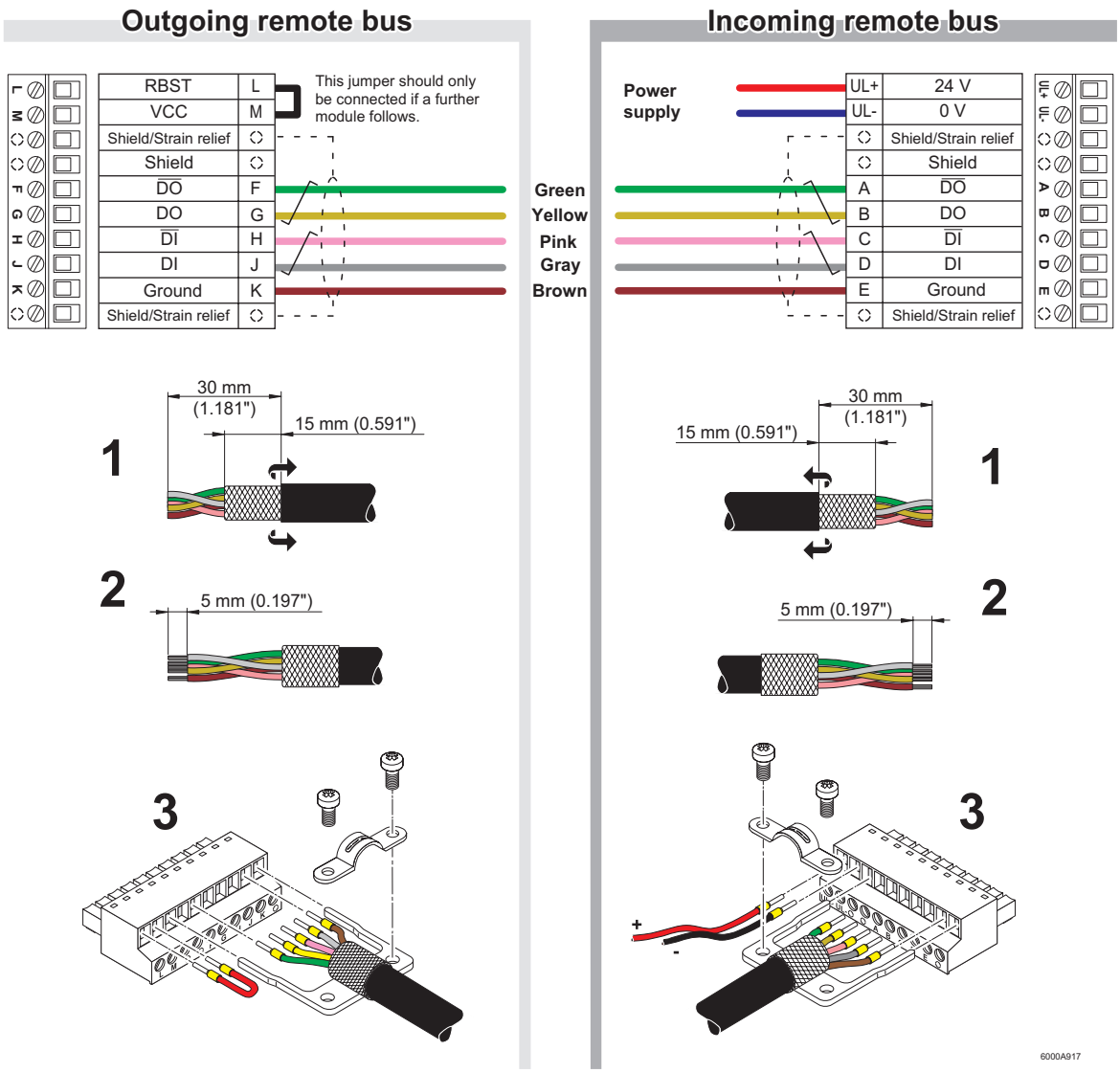


Figure A-17 10-pos. MINI-COMBICON/10-pos. MINI-COMBICON

For exact instruction see page 6-10

For exact instruction see page 6-10

Appendix A

B Technical Data of the Cable Types

B 1 Remote Bus Cable

Table B-1 Electric data for remote bus cable

Characteristic Size at 20°C (68.0°F)	Value	Test Method
DC conductor resistance per 100 m	9.6 Ω, maximum	VDE 0472-501 IEC 189-1 cl. 5.1
Characteristic impedance	120 Ω ± 20% at f = 0.064 MHz 100 Ω ± 15% at f > 1 MHz	IEC 1156-1 cl. 3.3.6
Dielectric strength Wire/wire Wire/shield	 1000 V_{rms}, 1 min 1000 V_{rms}, 1 min	VDE 0472-509 test type C IEC 189-1 cl. 5.2
Isolation resistance (after testing dielectric strength)	150 MΩ, minimum, for 1 km (0.621 mi.) cable	VDE 0472-502 test type B IEC 189-1 cl. 5.3
Maximum transfer impedance (coupling resistance) at 30 MHz	250 mΩ/m	IEC 96-1
Effective capacitance at 800 Hz	60 nF, maximum, for 1 km (0.621 mi.) cable	VDE 0472-504 test type A IEC 198-1 cl. 5.4
Minimum near-end crosstalk attenuation (NEXT) for 100 m (328.084 ft.) cable	At 0.772 MHz 61 dB At 1 MHz 59 dB At 2 MHz 55 dB At 4 MHz 50 dB At 8 MHz 46 dB At 10 MHz 44 dB At 16 MHz 41 dB At 20 MHz 40 dB	VDE 0472-517 IEC 1156-1 cl. 3.3.4
Maximum wave attenuation for 100 m (328.084 ft.) cable	At 0.256 MHz 1.5 dB At 0.772 MHz 2.4 dB At 1 MHz 2.7 dB At 4 MHz 5.2 dB At 10 MHz 8.4 dB At 16 MHz 11.2 dB At 20 MHz 11.9 dB	VDE 0472-515 IEC 1156-1 cl. 3.3.2

Remote Bus Cable: Standard

Used in standard permanent installations without any special mechanical strain

Designation:	IBS RBC METER-T
Order No.:	28 06 28 6
Structure:	3 x 2 x 0.22 mm^2 (24 AWG) Always 2 wires twisted as a pair, common shielding (tinned copper braided shield)
Sheath color:	Green RAL 6017
Cable diameter:	0.22 mm^2 (24 AWG)
Outside diameter:	7.2 mm (0.283 in.)
Bending radius:	Minimum 58 mm (2.283 in.) permanently installed
Ambient compatibility:	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Temperature range:	-30°C to +70°C (-22°F to +158°F) permanently installed
Color coding:	DIN 47100

Remote Bus Cable: Highly Flexible

Used in applications that require a highly flexible cable (e.g., trailing chains, frequently moving machine parts)

Designation:	IBS RBC METER/F-T
Order No.:	27 23 12 3
Structure:	3 x 2 x 0.25 mm^2 (24 AWG) Always 2 wires twisted as a pair, common shielding (tinned copper braided shield)
Sheath color:	Green RAL 6017
Cable diameter:	0.25 mm^2 (24 AWG)
Outside diam.:	8.1 mm (0.319 in.)

Bending radius:	122 mm (4.803 in.), minimum, flexibly installed
Ambient compatibility:	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Temperature range:	-40°C to +80°C (-40°F to +176°F) permanently installed -30°C to +70°C (-22°F to +158°F) flexibly installed
Color coding:	DIN 47100

Remote Bus Cable: Underground Installation

Using the remote bus for permanent indoor and outdoor installation and for underground installation. The outer sheath is resistant to ultraviolet rays.

Designation:	IBS RBC METER/E-T
Order No.:	27 23 14 9
Structure:	3 x 2 x 0.22 mm^2 (24 AWG) Always 2 wires twisted as a pair, common shielding (tinned copper braided shield with additional, reinforced PVC outer sheath)
Sheath color:	Black, RAL 9005
Cable diameter:	0.22 mm^2 (24 AWG)
Outside diameter:	9.3 mm (0.366 in.)
Bending radius:	75 mm (2.953 in.), minimum, permanently installed
Ambient compatibility:	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Temperature range:	-30°C to +70°C (-22°F to +158°F) permanently installed
Color coding:	DIN 47100

B 2 Installation Remote Bus Cable

Technical Data for INTERBUS Installation Remote Bus Cable

Table B-2 Electric data for installation remote bus cable

Characteristic Size at 20°C (68.0°F)	Value	Test Method
DC conductor resistance Per 100 m (328.084 ft.) signal line Per 100 m (328.084 ft.) supply line	 9.6 Ω, maximum 2.2 Ω, maximum	VDE 0472-501 IEC 189-1 cl. 5.1
Characteristic impedance of the data line pairs	120 Ω ± 20% at f = 0.064 MHz 100 Ω ± 15% at f > 1 MHz	IEC 1156-1 cl. 3.3.6
Dielectric strength Wire/wire Wire/shield	 1000 V_{rms}, 1 min 1000 V_{rms}, 1 min	VDE 0472-509 test type C IEC 189-1 cl. 5.2
Isolation resistance (after testing dielectric strength)	150 MΩ, minimum, for 1 km (0.621 mi.) cable	VDE 0472-502 test type B IEC 189-1 cl. 5.3
Maximum transfer impedance (coupling resistance) at 30 MHz	250 mΩ/m	IEC 96-1
Effective capacitance at 800 Hz	60 nF, maximum, for 1 km (0.621 mi.) cable	VDE 0472-504 test type A IEC 198-1 cl. 5.4
Minimum near-end crosstalk attenuation (NEXT) for 100 m (328.084 ft.) cable	At 0.772 MHz 61 dB At 1 MHz 59 dB At 2 MHz 55 dB At 4 MHz 50 dB At 8 MHz 46 dB At 10 MHz 44 dB At 16 MHz 41 dB At 20 MHz 40 dB	VDE 0472-517 IEC 1156-1 cl. 3.3.4
Maximum wave attenuation for 100 m (328.084 ft.) cable	At 0.256 MHz 1.5 dB At 0.772 MHz 2.4 dB At 1 MHz 2.7 dB At 4 MHz 5.2 dB At 10 MHz 8.4 dB At 16 MHz 11.2 dB At 20 MHz 11.9 dB	VDE 0472-515 IEC 1156-1 cl. 3.3.2

Installation Remote Bus Cable: Standard

Used in standard permanent installations without any special mechanical strain

Designation:	IBS INBC METER
Order No.:	27 23 13 6
Structure:	3 x 2 x 0.22 mm^2 (24 AWG) + 3 x 1.0 mm^2 (18 AWG) (Always 2 wires twisted as a pair (data) + 3 single conductors (power), common shielding (tinned copper braided shield)
Sheath color:	Green RAL 6017
Cable diameter:	0.22 mm^2 (24 AWG) (data) 1.0 mm^2 (18 AWG) (power)
Outside diameter:	7.9 mm (0.311 in.)
Bending radius:	64 mm (2.520 in.), minimum, permanently installed
Ambient compatibility:	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Temperature range:	-40°C to +80°C (-40°F to +176°F) permanently installed
Color coding:	DIN 47100 (data) Red, blue, green/yellow (power)

Installation Remote Bus Cable: Highly Flexible

Used in applications that require a highly flexible cable (e.g., trailing chains, frequently moving machine parts)

Designation:	IBS INBC-METER/S
Order No.:	27 59 87 0
Structure:	3 x 2 x 0.25 mm^2 (24 AWG) + 3 x 1.0 mm^2 (18 AWG) Always 2 wires twisted as a pair (data) + 3 single conductors (power), common shielding (tinned copper braided shield)

Sheath color:	Green RAL 6017
Cable diameter:	0.25 mm^2 (24 AWG) (data) 1.0 mm^2 (18 AWG) (power)
Outside diameter:	7.9 mm (0.311in.)
Bending radius:	119 mm (4.685 in.), minimum, flexibly installed
Ambient compatibility:	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Temperature range:	-40°C to +80°C (-40°F to +176°F) permanently installed -30°C to +70°C (-22°F to +158°F) flexibly installed
Color coding:	DIN 47 100 (data) Red, blue, green/yellow (power)

Installation Remote Bus Cable: Underground Installation

Using the installation remote bus for permanent indoor and outdoor installation and for underground installation. The outer sheath is resistant to ultraviolet rays.

Designation:	IBS INBC METER/E
Order No.:	27 23 15 2
Structure:	3 x 2 x 0.22 mm^2 (24 AWG) + 3 x 1.0 mm^2 (18 AWG) Always 2 wires twisted as a pair (data) + 3 single conductors (power), common shielding (tinned copper braided shield with additional, reinforced PVC outer sheath)
Sheath color:	Black, RAL 9005
Cable diameter:	0.22 mm^2 (24 AWG) (data) 1.0 mm^2 (18 AWG) (power)
Outside diameter:	9.4 mm (0.370 in.)
Bending radius:	76 mm (2.992 in.), minimum, permanently installed

Ambient compatibility:	Free from substances which would hinder coating with paint or varnish (according to VW specification)
Temperature range:	-30°C to +70°C (-22°F to +158°F) permanently installed
Color coding:	DIN 47100 (data) Red, blue, green/yellow (power)

C Reference Data

C 1 List of Figures

C 2 List of Tables

C 3 Glossary

1

1-wire termination

Connection method for I/O modules with one connection per I/O channel. This wire transmits the signal. I/O module and sensor or actuator must have a common potential.

2

2-wire termination

Connection method for I/O modules with two connections per I/O channel. One wire transmits the signal, the other transmits the common potential.

3

3-wire termination

Connection method for I/O modules with three connections per I/O channel. One wire transmits the signal, one the common potential and the third a further common potential (e.g. shield or ground).

4

4-wire termination

Connection method for I/O modules with four connections per I/O channel. One wire transmits the signal, one the potential and the third and fourth are designed for the connection of the shield and ground.

A

Active configuration

The active configuration is the parameterization with which the controller board operates the current bus configuration (the bus is in ACTIVE or RUN state) in which the complete bus configuration is known.

→ *Known configuration*

Actuator

An actuator is a device which can change the behavior of a process and thereby causes a change in the process variables. Actuators are for example, lamps, switches, relays etc.

Address

The address defines a certain memory space. With access to the memory space, data can be written to or read from this space.

Addressing

Addressing is the way in which addresses are assigned. With INTERBUS there is user-defined addressing and automatic addressing.

Alternative

An alternative is a part of the configuration that can be connected to a certain bus terminal module as an alternative to other configuration parts. It is entered in the low byte of the group number.

→ *Group number*

Alternative group number

The alternative group number clearly identifies an alternative part of the configuration.

Analog input

An analog input is an input for receiving analog signals.

Analog output

An analog output is an output at which analog signals are provided.

Application process

An application process is a part of an application program used to carry out a particular task.

Application program

An application program is a user program that exchanges process and parameter data with INTERBUS devices via INTERBUS.

Automatic addressing

Automatic addressing is an assignment of process data (of devices) to the memory area of a control or computer system. Automatic addressing assigns the process data automatically to the memory according to the physical location of the devices in the bus. The process data must be assigned again if new devices are added at a later date.

Automation system

An automation system is a group of devices that enable the complete automation of systems and processes.

B

Base address

The base address is a memory address that serves as the starting address for registers. All other addresses are located by adding a value (offset) to the base address.

Baud rate

The baud rate is the speed of data transmission (bits/s).

Binary input

A binary input is an input used to pick up binary signals which can only have two states.

Binary output A binary output is used to output binary signals which can only have two states.

Binary signal A binary signal is a digital signal with only two value ranges of the information parameter.

BK → *Bus terminal module (BK)*

Branch A branch is a subring system that branches off from the remote bus. A branch is connected to the remote bus using a bus terminal module. The bus terminal module offers the possibility of disconnecting the branching bus segments.

Branch A branch is an extension of the local bus. It is integrated in a local bus via a branch terminal and enables the connection of another physical local bus. The branch is in the same device level as the local bus and is not switchable. An example of this is the integration of an INTERBUS Loop in an INTERBUS Inline station.

Branch segment interface The INTERBUS interface of an INTERBUS device via which the data of this device leaves into another device level (branch) or into the same device level (branch).

Bus A bus is a system for transmitting data, signals and if necessary power supplies between several settings (devices, automation stations) via a common cable system. Set conditions and protocol via data exchange apply for the transmitted data, for the connection of the settings and for the exchange of data between the settings. The term "bus" is independent from the topology used e.g., line, ring, star.

Bus configuration The bus configuration is the physically existing sum of the devices connected to the controller board. The bus configuration consists of the INTERBUS cables and other devices (e.g., interface converter for fiber optic/two-wire, slip ring converter) which are required for the data transmission.

Bus cycle error → *Single error*

Bus device → *Device*

Bus diagnostics → *Diagnostics*

Bus segment A bus segment consists of a remote bus device and the I/O modules connected to it. The preceding cable is also part of the segment.

Bus segment number → *Segment number*

Bus terminal module (BK) The first step in setting up a modular I/O station is to connect a bus terminal module to the remote bus. I/O modules may be installed branching off from these bus terminal modules, to create a local bus. Using an additional interface a remote bus branch, local bus branch or installation remote bus can also be connected. A bus terminal module, used for signal gain (repeat function), divides the system into segments, thus allowing you to switch off single branches during operation. In addition, the electronics module supplies communications power to the connected I/O modules.

Bus topology → *Topology*

Byte module All devices with an odd number of bytes count as byte modules. When automatic addressing is used, each byte module occupies a new byte address.

C

Client A client is a communications device that requests a service from a server.

Client-Server model This model defines the communication mechanisms between a service requester (client) and a service provider (server). With these communication mechanisms the client can use the functions of the server. With communication services the functions of the server can be accessed.

Communication reference The communication reference is a number which is assigned to each PCP device. It designates the address of the logical connection. The INTERBUS controller board always has the communication reference 1. The user can assign the communication references 2 to 64 in succession.

Communication register The communication register is an input address area and output address area that is always mapped in the control system. This area is used as an interface for the driver blocks and management services, for communication with intelligent field devices (PCP) and for process data transmission. The communication register occupies two successive words in the address area of the PLC.

Communication relationship With PCP communication, the communication relationship establishes the logical connection between two devices. The requirement for this is the physical possibility for communication, i.e., both devices must be connec-

ted with each other via the network and be PCP-compatible. The communication relationship list stores information about each communication relationship.

Communication relationship list

A communication relationship list is a list for PCP communication in which the connection parameters of the communication relationship are stored between two devices. During connection establishment, a compatibility check of the connection parameters in the CRLs of both devices is made. The relevant connection parameters are the transmit and receiver buffer sizes as well as the supported PCP services. Instead of connection parameters, one also speaks of suitable context conditions. The communication relationship list of a device contains the description of all communication relationships of this device regardless of when they are used.

Communication service

A communication service is a service used for establishing and aborting a connection as well as in data exchange between two devices.

→ *PCP service*

Compact module

The compact modules have a housing with IP 65 protection and are used in the installation remote bus. The sensors and actuators are connected using IP-65 circular connectors.

Complete bus configuration

The complete bus configuration contains the current bus configuration (i.e., the stored configuration) including all alternative groups and disconnected devices.

→ *Current bus configuration*

Component

Devices, units or application programs that are the part of an automated system.

Configuration

→ *Configuration frame*

Configuration frame

The configuration frame contains the entire configuration of the controller group including all groups and alternatives. The configuration frame contains all devices of the complete bus configuration.

Confirmation

A confirmation is a service response of the server to a request of the client. The confirmation is sent as a response from the server.

Connected bus configuration

→ *Current bus configuration*

Connecting cable	→ *RS-232 cable*
Control or computer system	(Automation) equipment or computer system which is connected to INTERBUS through the controller board or the slave board.
Controller board	The controller board connects programmable logic controllers (PLCs) or computer systems (PC, VMEbus etc.) to the INTERBUS sensor/actuator bus. It carries out the master function in the INTERBUS system. It controls the data communication in the INTERBUS system, independent of the control or computer system in which it is installed. Controller boards are available for all popular computer or control systems.
CR	→ *Communication reference*
CRC	→ *Cyclic Redundancy Check*
CRL	→ *Communication relationship list*
Current bus configuration	The current bus configuration is the physical bus configuration which the controller board is operating at present.
Current carrying capacity	The current carrying capacity is the maximum permissible current load with which a system or a component may be operated without being damaged.
Current configuration	→ *Active configuration*
Currently connected bus configuration	All INTERBUS devices, INTERBUS cables and other devices, which are connected physically with the controller board at present. Some of these devices can be switched off. They are then not part of the active configuration. → *Active configuration*
Cycle error	→ *Single error*
Cycle time	The cycle time is the time which the INTERBUS system requires in order to read all data from the devices and to write all data to the devices.
Cyclic Redundancy Check	The Cyclic Redundancy Check is a test method for data integrity in which a data block is divided by a standardized polynomial and the rest of the division is appended as a CRC check word to the user data block to be transmitted.

D

Data consistency

The data consistency is the amount of data that an MPM node can read or write without another MPM node simultaneously accessing this data. Word-by-word access is set as a default. Other consistency areas that can be set are 8, 16, 32 and 64 bits.

Device

General term for devices with different functions and fields of application, which participate in the data exchange in the INTERBUS system (e.g., controller boards, interface boards, bus terminal modules, various I/O modules, high-tech controllers, drive controllers, valve manifolds, encoders, ID systems, operator panels and display devices). Each device has only one protocol chip. The devices are identified through the device code. There are also modules that include several devices (e. g., the IBS ST 24 BK RB-T module).

Device

Specifically for INTERBUS: All technical settings to be used for the data transmission via INTERBUS.

Device code

The device code is a data word to identify the characteristics of an INTERBUS device. It consists of the length code (high byte) and ID code (low byte).

Device number

With INTERBUS, there are logical and physical device numbers.

→ *Device number, logical*

→ *Device number, physical*

Device number, logical

Each INTERBUS device of a configuration frame is assigned a unique logical device number. This device number is specified in the "Segment.Position" (Seg.Pos) form. The logical device number 0.0 is reserved for the controller board. The numbers "1.0" to "254.254" can be assigned. Each remote bus device receives the position number 0. Every local bus device receives the segment number of the associated remote bus device.

Device number, physical

The physical device number identifies the order of the devices determined by the bus system structure. It is assigned from 1 to 512 in an ascending order without gaps.

Device type

Device type means remote bus device, local bus device etc.

Diagnostics

Diagnostics provide information on the status of the bus such as number of bus cycles or number, location and type of errors that occurred.

Diagnostics Guide

This guide describes the operation and display possibilities of the diagnostic display (display or LEDs). It also contains common error messages and troubleshooting tips. The appendix of the Diagnostics Guide contains information about how to replace defective INTERBUS devices. The pocket-size format was chosen so that you can take it with you when you install and start up the controller board in the system.

E

Electrical isolation

Electrical isolation means that the circuits of an electrical device are galvanically separated from each other.

Equipotential bonding

Equipotential bonding is an electrical connection that ties the exposed conductive parts of an item of electrical equipment and extraneous conductive parts to the same, or approximately the same, potential in order to prevent disturbing or dangerous voltages between these parts.

Extended installation remote bus

The extended installation remote bus is an installation remote bus with a current carrying capacity of 16 A instead of the normal 4.5 A.

F

FC

→ *Field Controller*

FE

→ *Functional earth ground*

Fiber-optic BK module

A bus terminal module using fiber optics to connect system parts between which there is no equipotential bonding and for environments with heavy electromagnetic interference.

Field Controller

The Field Controller (FC) is used to control an INTERBUS network. Unlike the controller board, the FC is not connected to a control system, but operates autonomously. Programming takes place using PC WORX in accordance with IEC 61131.

Full duplex

Sending and receiving data at the same time.

Function result bit

This bit indicates the result of the executed function (with or without error).

Function result register

This register indicates the result of the executed functions (with or without error).

Function start bit The function start bit starts a function on the controller board.

Function start register The function start register is a register via which the functions defined by the user can be started.

Function status bit The function status bit is used to indicate the status of a function (is performed or is completed).

Function status register The function status register is a register which indicates the status of the functions (are performed or are completed).

Functional earth ground A low-impedance current path between electric circuits and ground. It is not designed as a safety measure but rather, for example, for the improvement of noise immunity.

G

Gateway A gateway interconnects several data networks of different characteristics (e. g. bit rate, protocol). In the INTERBUS it is the gateway that indicates the INTERBUS device that couples other transmission systems to INTERBUS.

Group definition The group definition is a freely selected definition to combine INTERBUS devices which are located anywhere in the bus configuration to one (logical) group.

Group number Devices can be combined to a group with the group number. The group number consists of the group (high-order byte) and the alternative (low-order byte).

H

Host Host is the denomination for the control or computer system into which the controller board is integrated.

Host system → *Host*

Hybrid transmission method Hybrid transmission method means that process data and parameter data is transmitted simultaneously.

I

I/O device

An I/O device is an INTERBUS device that transmits the input process data and/or output process data.

I/O gateway

An I/O gateway interconnects two independent INTERBUS systems on process data levels. It occurs in both systems as a device.

I/O module

I/O modules connect INTERBUS to the sensors and actuators.

IB

→ *INTERBUS*

IBS

→ *INTERBUS*

IBS CMD SWT

The IBS CMD program is a user interface for INTERBUS on IBM-compatible PCs under Windows. It enables simple, menu-driven project planning, configuring, operation and diagnostics of INTERBUS. With IBS CMD, the functions of the INTERBUS components (controller boards, modules, etc.) can be used without extra programming work.

ID code

Each INTERBUS device has an ID code (Identification Code) so that the controller board can identify the device. The ID code indicates the device type. It provides information about it, whether it is an analog or digital module or a bus terminal module, whether it is an input or output module and whether it is a PCP device. It occupies the low-order byte of the device code.

ID cycle

The controller board uses the ID cycle to determine the connected bus configuration. The following information is read in: The number and order of modules, ID code and process data length.

IN data

→ *Input data*

IN process data

→ *Input process data*

Incoming interface

The incoming interface is the INTERBUS interface of an INTERBUS device, via which it can receive data.

Indication

An indication is a service request received by the server following a request from the client. The server responds to the indication with a response.

Input

Connection point of a circuit or a device to which a signal can be connected which is to be processed, amplified, stored or linked with other signals.

Input address area

The input address area is an area in which the INTERBUS devices store their data for the control system.

Input data

Input data is data that is transmitted from an INTERBUS device to an application program.

Input process data

Data, which is transmitted from a device to an application program is input process data (IN-PD) for this application.

Installation local bus

The installation local bus connects installation local bus devices. There are two types: INTERBUS Loop and INTERBUS Loop 2.

Installation remote bus (IRB)

The installation remote bus is a variant of the remote bus. As well as the wires for data transmission, the installation remote bus carries the supply voltage for the module electronics of the connected I/O modules and the sensors. The power is looped through a bus terminal module. In terms of topology the installation remote bus is a remote bus branch that can be used to set up distributed substations. Sensors and actuators can be directly connected to these substations. (See also extended installation remote bus)

Installation remote bus device

An installation remote bus device is an INTERBUS device whose remote bus interface can provide an additional voltage for the supply of the module electronics and sensors.

INTERBUS

The INTERBUS is a fieldbus standardized according to EN 50254 (Volume 2) for the serial transmission of data from the sensor/actuator area.

INTERBUS devices

→ *Device*

INTERBUS Loop

The INTERBUS Loop can be used to network sensors and actuators that are distributed at machines or in systems. Individual I/O devices with corresponding module electronics can also be connected to the INTERBUS Loop. The INTERBUS Loop is connected to the remote bus using a bus terminal module. The bus terminal module converts the remote bus signal to an INTERBUS Loop and provides the supply voltage. The Loop is a ring structure in which the first device is connected to the bus terminal module. The Loop cable is returned from the last device to the bus terminal module. The INTERBUS Loop can only be used with controller boards with firmware version 4.15 or later.

→ *INTERBUS Loop 2*

INTERBUS Loop 2

The INTERBUS Loop 2 is a further development of INTERBUS Loop. It features extended technical parameters and extensive diagnostics. The INTERBUS Loop 2 can be used to network sensors and actuators which are distributed on machines or in systems. Individual I/O devices with corresponding module electronics can also be connected to the INTERBUS Loop 2. The INTERBUS Loop 2 is connected to the remote bus using a bus terminal module or to an Inline station using a branch terminal. The bus terminal module/branch terminal converts the signals to an INTERBUS Loop 2 signal and provides the supply voltage. The Loop 2 is a ring in which the first device is connected to the bus terminal module/branch terminal. The Loop 2 cable is returned from the last device. The INTERBUS Loop 2 can only be used with controller boards with firmware version 4.4x or later.

INTERBUS S

→ *INTERBUS*

IRB

→ *Installation remote bus*

Known configuration

The known configuration is the INTERBUS configuration present in the main memory of the controller board.

L

Length code

The length code provides the number and type of representation of the process data (bit, nibble, byte, word). It uses the high-order byte of the device code.

Local bus

The local bus interconnects local bus devices and connects them to a bus terminal module. It branches off from the remote bus via a bus terminal module. A local bus belongs to the segment of its bus terminal module. No additional branches are permitted within a local bus. The different types are as follows:

- ST local bus (connects ST modules)
- Installation local bus (connects INTERBUS Loop modules)
- Inline local bus (connects INTERBUS Inline terminals)
- Fiber-optic local bus (connects flat-pack I/O modules)

Local bus branch

A local bus branch can be started with a special bus terminal module which, apart from the standard interfaces, has an additional local bus interface. A local bus branch cannot have further sub-branches.

Local bus device Local bus devices are I/O devices used to set up a distributed sub-station in the control cabinet. The devices are connected to the remote bus using a bus terminal module.

Local bus error The local bus error is a bus error that occurs in a local bus.

Logical addressing → *User-defined addressing*

Loop-back word The loop-back word is the first word sent by the controller board. If the controller board receives the loop-back word back it knows that the cycle was run completely.

M

Master The master is a central device which controls the bus access. All other devices operate as slaves.

Master-Slave access method → *Master-Slave procedure*

Master-Slave procedure Access method during data exchange: only one central station exists - the master. This station controls the bus access. All other stations, the slaves, can only send a message when requested to do so by the master.

Memory card → *Parameterization memory*

Module A term for INTERBUS devices from Phoenix Contact.

N

Network A network is a communication link which connects devices together. The link operates under a protocol that is understood by all devices.

O

OUT process data → *Output process data*

Outgoing interface The INTERBUS interface of a device where the data leaves the device on the same device level (Display: OUT1).

Output address area The output address area is an area in which the control system stores data which is to be transmitted to the INTERBUS devices.

Output data Output data is data which the INTERBUS master (controller board) transmits to the INTERBUS slaves (INTERBUS devices).

Output process data Data which an application program sends to a device is OUT process data for this application program.

P

Parameter channel The parameter channel is a data transmission channel for transmission of device parameters, domains and services to these domains (functions).

Parameter channel (PCP) Parameter channel (PCP) is a term in INTERBUS data sheets which gives the width of a parameter channel of an INTERBUS device as the number of PCP bytes.

Parameter data Parameter data is complex data records from intelligent devices like frequency inverters or controllers. Parameter data is e.g., data that is used for the startup phase of machines. Such parameter data must only be transmitted if required. Parameter data and process data is transmitted at the same time. Therefore it must be divided into small units. In the INTERBUS system the PCP divides the parameter data into single segments and recombines the data after transmission.

Parameterization memory	The parameterization memory is a memory on the controller board for the resident storage of parameterization and diagnostics data. Types: – fixed EEPROM (Flash EPROM) – plug-in EEPROM card- plug-in memory card (buffered SRAM)
PCP	PCP (Peripherals Communication Protocol) belongs to the INTERBUS protocol and controls the transmission of parameter data. Special PCP services are available for this purpose.
PCP channel	The PCP channel is a communications channel that must be open in order to exchange parameter data with a PCP device.
PCP device	A PCP device is an INTERBUS device which supports the Peripherals Communication Protocol (PCP).
PCP service	Service used with PCP communication to establish and abort a connection as well as in data exchange between two devices.
PD	→ *Parameter data*
PDC	→ *Parameter channel*
PE	→ *Protective earth ground*
Peripheral fault (PF)	The PF message indicates an error within the periphery of an INTERBUS device.
Peripherals Communication Protocol	→ *PCP*
PF	→ *Peripheral fault*
Physical addressing	→ *Automatic addressing*
Position	The position is a logical number that uniquely identifies a device within a local bus.
Position number	The position number is the low byte of the logical device number. (See also device number, logical)
Power bus	The power bus is a bus for the transmission of power for the power electronics.

Power supply

All components which are used to generate and transmit the supply voltage.

Process data

Process data is input and output information sent to and from INTERBUS devices. Process data changes continually and must be continually updated. This information must be transmitted quickly and at regular intervals via the process data channel.

→ *Parameter data*

Process data channel

The process data channel transmits data in an unacknowledged way and at regular intervals (equidistant). The direction of the process data is regarded as from the host system to the bus i.e.,

– OUT process data is data which the host system writes to the process data channel.
– IN process data is data which the host system reads out of the process data channel.

Process image

The process image contains all process data that is available at a certain point in time.

Protective earth ground

A low-impedance path that minimizes the risk to a user in the event of an error (including a high voltage and/or current error between an electrical circuit and ground).

Protocol

A protocol is a set of conventions. It defines data formats and control procedures for communication between devices or processes.

R

RB

→ *Remote bus*

Reference Manual

The Reference Manual contains a description and the structures of all functions e.g., of function blocks, PCP services and firmware services.

Register length

The register length is the number of bytes which an INTERBUS device occupies in the INTERBUS ring. This information is required to calculate the cycle time.

Remote bus

The remote bus interconnects remote bus devices and connects them to the controller board. All devices that are connected to the remote bus must be supplied with external power.

→ *Installation remote bus (IRB)*

Remote bus branch

A remote bus branch can be started with a special bus terminal module which, apart from the standard interfaces, has an additional remote bus interface. A remote bus can be further branched. Up to 16 bus levels (branches) are permitted.

Remote bus cable

A remote bus cable connects two remote bus devices. The following versions exist:

– Copper (twisted pair)
– Fiber optics in different versions

Remote bus devices

Remote bus devices are INTERBUS devices with a remote bus interface. These include bus terminal modules, certain I/O modules or a combination of both, as well as devices such as frequency converters from third-party manufacturers. Remote bus devices always have an external supply voltage.

Remote Field Controller

The Remote Field Controller (RFC) opens an INTERBUS system in a higher-level network (e. g. Ethernet or INTERBUS). The programming takes place with PC WORX in accordance with IEC 61131.

Request

Request of a service through the service requester (client). The client receives a confirmation as a response. The request is received as an indication from the server.

Response

A response is a reply of the server to an indication of the client. The reply is received as confirmation from the client.

RFC

→ Remote Field Controller

Ring structure

The ring structure is a network topology in which the cable forms a closed ring. All devices in this ring are connected to the bus system. The forward and return lines can be run within a cable so that the ring structure physically corresponds to a tree structure.

RS-232 cable

The RS-232 cable is a serial cable for communication between the controller board and a PC on which an INTERBUS configuration software runs.

This cable used to be referred to as the diagnostics cable or connecting cable.

S

SµPI

→ *SUPI*

SAB

→ *Sensor/actuator box*

Segment

→ *Bus segment*

Segment number

The segment number is the high byte of the logical device number.

→ *Device number, logical*

Sensor

A sensor is a device that accepts the physical size of a process. The sensor determines the process variables.

Sensor/actuator box

A family of IP 67 modules designed to be used without an enclosure. The sensors and actuators are connected via M12 circular connectors.

Serial data transmission

With serial data transmission the bits are transmitted after one the other to a cable.

Server

A server is a communication device that responds to a service from a client. The server makes its objects available to other devices through a service.

Shield

A shield is a complete or partly completed electrical or magnetic conductive shielding which should minimize receiving or transmitting interference signals.

Shift registers

A shift register is a register whose content is shifted by a certain number of positions in each cycle.

Single error

An error (for instance a CRC error) that occurs within a bus cycle. This means the data of this cycle is completely lost. A single error does not generate an error message and does not cause a bus failure.

Slave

A slave is a device in the network that can only participate in data exchange after it has been addressed by the master.

Special function module — A special function module is a module with certain functions (e.g. counter module, V.24 module, incremental encoder module etc.)

ST compact station — An ST station is a special type of local bus. An INTERBUS ST compact station is coupled to the remote bus using an ST bus terminal module. It consists of up to eight ST modules that are directly connected with each other.

Status indication — LED or LCD displays on controller boards or modules that provide information on the status of the inputs/outputs.

Summation frame — The summation frame is a transmission protocol in which all physical INTERBUS devices are treated as if they were one logical device. All process data is accepted from all devices and transmitted to all devices simultaneously during a cycle. On the basis of the location of the information in the summation frame, each INTERBUS device can accept the data that is determined for it.

SUPI — "Serial Universal Protocol Interface"

The SUPI is a protocol chip for INTERBUS devices.

Supply voltage — A specific value, entered in Volts.

System — Devices that are connected together for a particular purpose which should operate as a single functional unit.

System coupler — The system coupler links two INTERBUS systems hierarchically with each other. It appears as a device (slave) for the higher-level system and as a controller board (master) for the lower-level system.

System Manual — The system manual is a comprehensive collection of information on INTERBUS products.

T

Topology — The topology is the way in which a network is structured e. g., ring, tree or star.

→ *Ring structure*

Transmission medium

Apart from the standard transmission over twisted-pair cables made of copper, INTERBUS can also transmit the data using other media such as fiber optics, slip rings and infrared transmission paths. This allows you to connect parts of a plant to INTERBUS that cannot be accessed with standard copper cable.

Transmission time

The transmission time is the interval between the start of data being transmitted by one functional unit and the end of this data being received by the other.

U

User data

In a data telegram, user data is all transmitted data that is not frame data.

User Manual

The User Manual contains a user-orientated description of the INTERBUS products with procedures, examples etc.

User-defined addressing

User-defined addressing is an assignment of process data (of devices) to the memory areas of a control or computer system. With this addressing the process data is (almost) freely assigned to the memory by the user. The assignment is independent of the physical location of the devices in the bus. This way, it is possible to insert further devices in the bus at a later date, without changing the assignment of the process data in the process image of the control or computer system.

V

V.24 module

The V.24 module allows for the connection of intelligent I/O equipment without an INTERBUS interface to an INTERBUS system such as, for example, automation equipment, protocol printers, identification systems or process controllers. For serial data transmission the RS-232, RS-485 or RS- 422 standard interfaces may be integrated into the module.

W

Word module

All devices with an even number of bytes count as word modules.

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